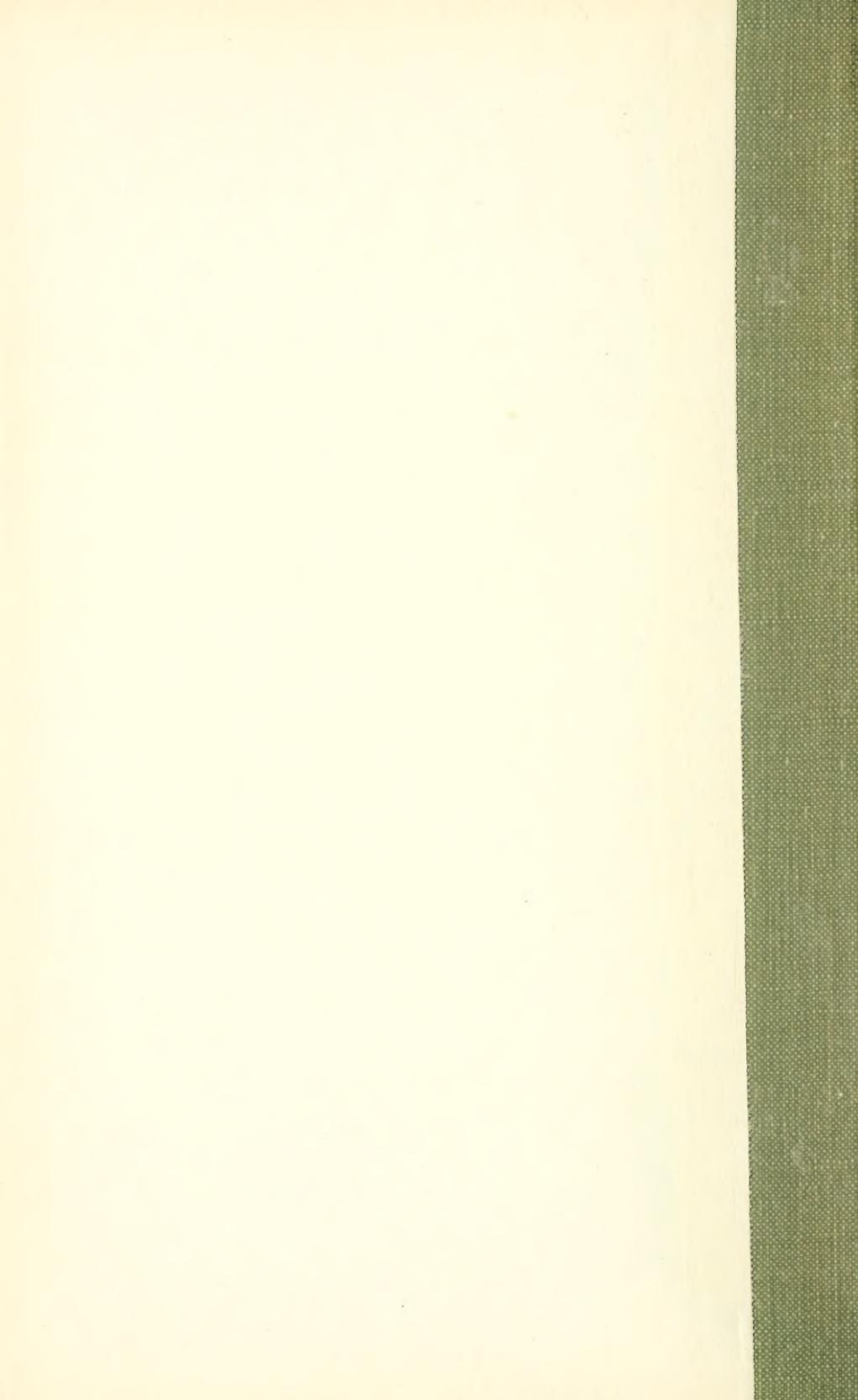


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Field Museum of Natural History

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THE WHITE-TAILED DEER



No. 1



FIELD MUSEUM OF NATURAL HISTORY

CHICAGO

1922



WHITE-TAILED DEER IN SUMMER.

FROM GROUP IN FIELD MUSEUM OF NATURAL HISTORY.

FIELD MUSEUM OF NATURAL HISTORY
DEPARTMENT OF ZOOLOGY
CHICAGO, 1922

LEAFLET

NUMBER 1

The White-Tailed Deer

The common deer of eastern North America was one of the first of our large mammals to be brought to the attention of early settlers. Although originally abundant in Massachusetts and other parts of New England, it seems to have been reported especially from Virginia by early French writers who called it *Cerf de Virginie*. It was then given the scientific name *Cervus virginianus* and so came to be known generally as the Virginia Deer. In later years this name proved to be misleading, for the same species of deer, or varieties differing slightly in size and color, was found to be present not only in Virginia but over most of the eastern and central United States. Another name for it, therefore, has gradually come into use, the name White-tailed Deer. This is frequently shortened to Whitetail, which is a very appropriate name, for the deer's tail is entirely white on the under side and when held erect, as the animal dashes through the woods, is very conspicuous. The upper side of the tail, however, is not white but reddish brown or gray the same as the back and sides of the body.

The White-tailed Deer withstands the advance of civilization much better than most of our larger mammals and is still common over much of its original range. In Pennsylvania, Virginia, and in parts of New York and New England, where elk, bison, bears, cougars and wolves have completely disappeared, the Whitetail still flourishes. This, of course, is mainly on account of the protection afforded by good game laws,

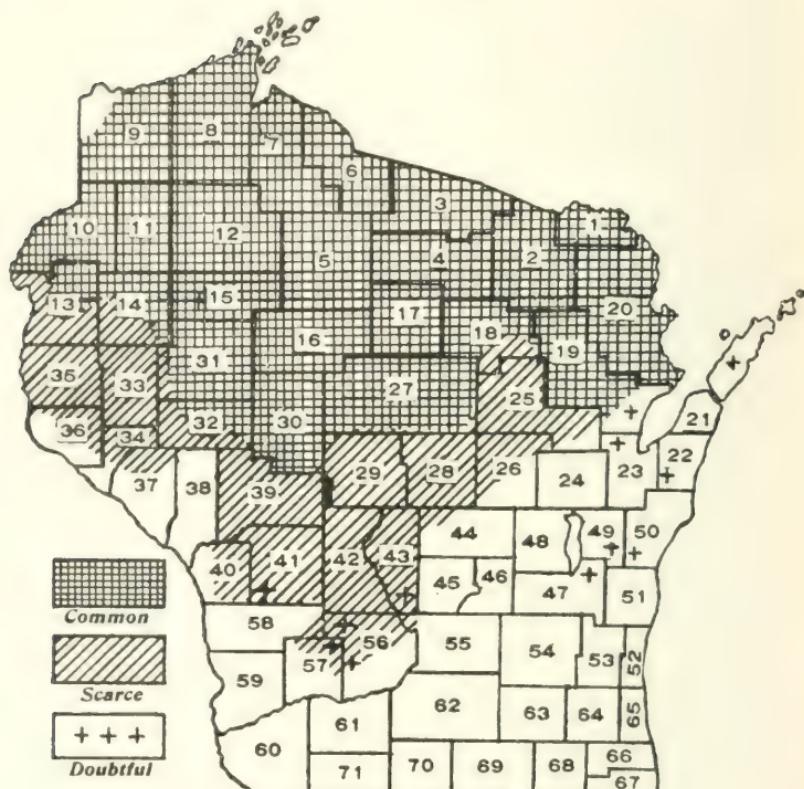
but it is also due in part to the animal's habits which are very adaptable. It will often maintain itself for years in a small piece of woodland only a few square miles in extent. Its original range included all of eastern North America from the mouth of the St. Lawrence River west to the Rocky Mountains and south to the Gulf of Mexico. Throughout Ohio, Indiana, Illinois and most of Missouri, Kansas and Nebraska, it is now wholly exterminated, but elsewhere it remains common wherever there is sufficient cover for it to exist. Except in the extreme western part of its range it is the only species of deer to be found. In southern Michigan and southern Wisconsin it has retreated before civilization and intensive cultivation of the land, but in the northern parts of these states it is exceedingly abundant. In Illinois, it is probably entirely extinct, although as recently as 1909 it was reported from Union and Alexander counties in the extreme southern part of the state.

The whitetails of the eastern United States are divided into several varieties or subspecies, as follows: The Virginia Whitetail (*Odocoileus virginianus*), which is of medium size and is now found principally in Virginia, West Virginia and the Carolinas; the Northern Whitetail (*Odocoileus v. borealis*), which is the largest variety and which ranges from Maine and New Brunswick westward at least to Manitoba; the Plains Whitetail (*Odocoileus v. macrourus*), which is said to have an unusually long tail and which formerly inhabited river bottoms throughout the Great Plains region, but is now almost extinct; the Florida Whitetail (*Odocoileus v. osceola*), which is the smallest variety and is confined to Florida; and the Louisiana Whitetail (*Odocoileus v. louisianae*), which is relatively large in size and inhabits the lowlands of Louisiana and eastern Texas. Besides these of the United States

there are various other whitetails, or closely allied species, inhabiting Mexico, Central America and northern South America. Thus, the whitetails, as a group, have a more extensive distribution than any other American deer.

Perhaps because it is so common and so well known, the Whitetail does not always get full credit for its grace and beauty which are scarcely excelled by any other member of the deer family either in America or in the Old World. No prettier woodland picture ever greets the nature lover's eye than that of our own deer as it threads its way along its forest trail or steps alertly at nightfall from the green depths to the open border of lake or stream. When in motion, especially when not alarmed, it has an ease and grace beyond that of any other of our game animals. Its normal gait is that of running or trotting and, although it can and does make great leaps, it does not "bound" with all four feet striking the ground at once as do the western Blacktails or Mule Deer. If slightly startled, it moves away in low, springy jumps alternated at short intervals with single high leaps, the entire movement being characterized by an indescribable grace and resiliency. Meanwhile the head and long, flashing, white tail are held erect and the whole effect as the animal appears and reappears among the trees and bushes makes a beautiful sight.

The outward appearance of the Whitetail shows marked differences with the change of the seasons. In summer its hair is relatively short and thin and the color of its coat is rich reddish rufous. On this account, it has sometimes erroneously been called Red Deer, a name which properly belongs to a very different European species. This red coat is worn during the warm months from May until September in the period when the horns are attaining their annual growth.



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|------------------------|-----------------|------------------|----------------|
| 1. Florence. | 18. Langlade. | 36. Pierce. | 54. Dodge. |
| 2. Forest. | 19. Oconto. | 37. Buffalo. | 55. Columbia. |
| 3. Vilas. | 20. Marinette. | 38. Trempealeau | 56. Sauk. |
| 4. Oneida. | 21. Door. | 39. Jackson | 57. Richland |
| 5. Price. | 22. Kewaunee. | 40. La Crosse. | 58. Vernon. |
| 6. Iron. | 23. Brown. | 41. Monroe. | 59. Crawford |
| 7. Ashland. | 24. Outagamie. | 42. Juneau. | 60. Grant. |
| (inc. Apostle Islands) | 25. Shawano. | 43. Adams. | 61. Iowa. |
| 8. Bayfield. | 26. Waupaca. | 44. Waushara. | 62. Dane. |
| 9. Douglas. | 27. Marathon. | 45. Marquette. | 63. Jefferson. |
| 10. Burnett. | 28. Portage. | 46. Green Lake. | 64. Waukesha. |
| 11. Washburn. | 29. Wood. | 47. Fond du Lac. | 65. Milwaukee. |
| 12. Sawyer. | 30. Clark. | 48. Winnebago. | 66. Racine. |
| 13. Polk. | 31. Chippewa. | 49. Calumet. | 67. Kenosha. |
| 14. Barron. | 32. Eau Claire. | 50. Manitowoc. | 68. Walworth. |
| 15. Rusk or Gates, | 33. Dunn. | 51. Sheboygan. | 69. Rock. |
| 16. Taylor. | 34. Pepin. | 52. Ozaukee. | 70. Green. |
| 17. Lincoln. | 35. St. Croix. | 53. Washington. | 71. Lafayette. |

PRESENT RANGE OF WHITE-TAILED DEER IN WISCONSIN

From Cory's Mammals of Illinois and Wisconsin

In the fall it is replaced by a beautiful gray coat which gradually grows longer and thicker as cold weather comes on until in midwinter it is full and heavy, forming an ample protection against the severest weather. In spring this coat is more brownish in color and after the long winter is apt to have a ragged and faded appearance, especially just before it is shed and followed by the reddish summer coat. The fawns, which usually are born in May or June, are reddish like the adults at the same season, but are beautifully spotted with white. Late in the fall when the first coat is shed, the fawns lose their spots and become grayish. Two fawns are commonly born at a time and rarely there are three. Young does, as a rule, produce only one fawn and the number varies somewhat in different parts of the country. Male fawns follow their mother for the first year and females often do so for two years.

Like other members of the deer family, the White-tail sheds and renews its horns annually. The does, or females, never have horns, but the bucks grow a new pair every year. The shedding takes place in late winter or early spring and there is a short period at this time, therefore, when there are no horns in either sex. The mature horns, which are carried through the winter, simply drop off and fall to the ground, leaving only the slight bony knob or pedicel from which they grew. Almost immediately new horns begin to grow, appearing at first as soft prominences covered with the peculiar fuzzy skin which is known as the "velvet." They rapidly elongate and send out branches which are nourished by a copious supply of blood flowing under the protecting velvet. In a few months their growth is practically completed and except for their velvet covering and the club-shaped tips, which harden last, they have much the appearance of mature antlers. Early in the fall, usually in September, the bucks rub their antlers against trees and bushes and the velvet

comes off in bloody strips and shreds until the fully hardened, smooth horn is exposed and ready for the running and fighting which takes place soon after. The antlers vary in size and form according to the age of the animal. The young buck in his second year has only simple unbranched prongs and therefore is called a "spike" or "spikebuck." In his third year, several additional points are gained but the antlers are relatively small. Full development of the gracefully curved and branched antlers comes in the fourth, fifth, and sixth years when the bucks are in their prime. With advancing years, the antlers may continue of fair size but they are less regular in shape, have fewer points, and are said to be "going back." The normal life of these deer is seldom over ten years.

The habits of the Whitetail vary somewhat according to the region it inhabits, but it always frequents the thickest cover available. In our northern states, it haunts the deep forest, the thickets of alders and willows bordering streams, and the dense growths in swampy flatlands. In summer, like its big cousin, the moose, the Whitetail feeds to some extent on aquatic plants to secure which it wades about shallow coves in lakes and ponds. It does this in broad daylight in remote regions where it is undisturbed, but where man frequently crosses its path, it keeps to cover during the day and only ventures into the open in the darkness of night. It is an excellent swimmer and will voluntarily cross large lakes. When pressed by wolves or dogs it frequently takes to the water. It has even been found swimming in the sea from island to island or point to point on the coast of New England. It makes good time in the water, but unless it has too much of a start can be overtaken by good paddlers with a canoe. Aquatic plants form only part of its food during the summer, for it eats a variety of browse in-

cluding many tender shoots of small bushes and it is by no means averse to grazing when the marsh grass is abundant.

In the fall, the deer usually move to higher ground and often spend much time in tracts of burnt-over land where the second growth affords good cover. When beechnuts or acorns are available, they feed extensively on them and become very sleek and fat. At this season, the bucks clear their horns of velvet, their necks grow thickened and, as the rutting or mating season approaches, they become restless and roving. The period of the rut extends from late October to early December and is a time of great activity, especially for the bucks, which range far and wide in search of the does. When two bucks meet, a fight is almost a certainty and if they are well matched, the contest may last several hours. They rush together head on and, after locking horns, push each other backward and forward with mouths open and eyes glaring until one or the other acknowledges defeat by leaving the field to his adversary. They seldom gore each other seriously and usually suffer only bruising and temporary exhaustion, but occasionally there are fights to the death. Not infrequently their antlers become inextricably locked and the poor beasts, unable to loose themselves or to take nourishment, struggle to the point of total exhaustion and death. Evidences of these tragedies are found in the weathered skeletons with the bound antlers attached. Probably they are less frequent than might be supposed from the number of sets of locked antlers which are offered for sale by taxidermists and curio dealers, since it is not difficult for the unscrupulous to spring separate antlers into a locked position.

The antlers of the Whitetail may be distinguished from those of other American deer by several characteristics. The two main branches or beams have a

pronounced forward curve and the points all rise from the back and top of these beams almost perpendicularly. The pair of points nearest the base of the beams are much longer and more upright than in other American deer. The number of points is variable but normally a full grown buck has five or six well-developed points on each side, making ten or twelve in all. Abnormal heads may have several times as many, and in very unusual cases there have been known to be as many as seventy-eight points.

The Whitetail, especially in the northern part of its range, often finds the winter season a great hardship. The deep snows do not prevent it from feeding, for it is able to browse upon twigs and to paw the snow away to secure other food in protected places; but snow interferes greatly with its freedom of movement and makes it an easy prey to its arch enemy, the wolf. When the snow is deep, the deer range within very narrow limits and beat down paths which are followed day after day until a space of several acres may be covered with a network of them. Such places are called "yards" and the deer may congregate in one of them in numbers from two or three to a dozen or more. When forced to leave the yard by dogs or wolves they flounder in the drifts and are easily overtaken. When the snow is slightly hardened on the surface, a form of hunting called "crusting" is sometimes practiced by meat hunters with snowshoes which support them while the deer with their sharp hoofs break through at every leap. Needless to say, crusting is considered quite unsportsmanlike.

Among the different varieties of the Whitetail found in the United States there is much variation in size. The northern variety is much the largest, and full grown bucks from northern New England, Michigan, Wisconsin, and Minnesota will average slightly

more than 200 pounds live weight. Many have been killed which weighed over 300 pounds and there are some apparently reliable records of bucks weighing as much as 400 pounds. The does are smaller, weighing perhaps 150 pounds for the average. The small Florida Deer weighs scarcely more than half as much as its northern relative and 100 pounds is a good weight for a full grown buck. The maximum for bucks is scarcely more than 125 pounds and does, of course, are much smaller. The Virginia variety is intermediate in size between the northern and the Florida varieties.

The Whitetail has always been a favorite object of the chase. The Indian pursued it before the coming of the white man and made good use of its hide, its horns, and its flesh. The pioneer settler did the same, and buckskin breeches, horn implements, and venison steaks meant almost as much to him as they did to the aborigines. In later years, deer-hunting has furnished fascinating sport for thousands of Americans of all classes in practically every state in the Union. Today it still has innumerable devotees and although the season for shooting is now limited to a few weeks or, in some states, to a few days, there is never any lack of hunters. The methods of deer-hunting vary in different parts of the country, but the most sportsmanlike and at the same time the most difficult type of hunting can be practiced anywhere. This is the so-called *still hunting* in which the hunter pursues his game by daylight, following its track and using his wits against those of the alert and often crafty wild animal until he is able to approach within shooting distance of it. Such hunting requires great skill in woodcraft, much physical strength, and inexhaustible patience. It is practiced principally when there is light snow on the ground, making the tracks easier to follow, but it can be done by experienced men when there is no snow.

Where deer are very plentiful, it is possible for the hunter to take up first one trail and then another until fortune favors him and he suddenly comes upon his game and gets at least a running shot as it bounds away. Hounds are used frequently for deer-hunting and most commonly when several hunters station themselves at different points along runways known to be used by the deer, or near lakes to which the deer may take to escape the dogs. In southern states, dogs are sometimes trained as "slow trailers," meaning that they follow a deer's trail without baying and so slowly that the hunter can keep a few yards behind them ready to shoot if the deer is started. Lying in wait at salt licks or favorite feeding places is another method and a much more common one is that of "jacking" or hunting at night with a bright light. Hounding, jacking, killing in the water, night hunting, etc., are now in most states prohibited by law. All such methods may afford some excitement but require little or no skill and if permitted would soon cause the extinction of the deer.

No game animal affords better evidence of the effectiveness of good game laws than the White-tailed Deer. In some of our most populous states it is still abundant, and during the short open season each year thousands are killed by sportsmen. In Vermont, where it was nearly extinct, and in New Jersey, where it was quite so, it has re-established itself successfully after a period of complete protection. In 1920, over 4,000 deer were legally killed in Vermont, whereas 25 years ago, scarcely a one could be found. In New York and Pennsylvania it is probable there are more deer now than 50 years ago, although of course they are not so widely distributed. In northern Michigan, Wisconsin and Minnesota, deer are perhaps as abundant as ever they have been. The number of buck deer legally killed

in New York State in 1918 was 8,293; in Pennsylvania in 1919, it was 2,913; and in Minnesota in 1919, both bucks and does were killed to the tremendous total of 18,572. In 17 states east of the Mississippi River, an estimate of the number of deer killed in 1910 was 60,-150. These results have been accomplished by well-conceived and well-administered game laws. At first these merely limited shooting to certain seasons of the year and protected the animals only while the young were being born and partly reared. Later, more restrictions became necessary, such as shortening the season, requiring licenses of hunters, limiting the number permitted to be killed by any one hunter, regulating interstate commerce in game, prohibiting the sale of venison, and wholly prohibiting the killing of does and fawns. The so-called "buck law," by which only males can be legally killed at any season, thus completely protecting the does and fawns, is on the statute books of about half the states and there are fifteen states (including Illinois and Indiana) in which deer hunting is entirely prohibited for a period of years.

Another recent development has been the establishment of both public and private preserves and game refuges. Game farming is also practiced successfully and deer are kept in semi-domesticated conditions in large enclosures and sold under special regulations for their meat or for restocking and propagation purposes. With the good laws now in force and with the demonstrated capacity of the deer to thrive in limited areas in close proximity to man, there is every reason to hope that the White-tailed Deer, perhaps the most attractive of all our game animals, may remain a feature of our woodlands for many years to come.

WILFRED H. OSGOOD,

Curator of Zoölogy.

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- NELSON, E. W.—*The Larger North American Mammals*, pp. 456-458 (Nat. Geog. Mag., Nov., 1916).
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The White-tailed Deer is especially well shown in the Field Museum by a large four-season group in the east end of Hall 16 on the Main Floor. This includes four divisions representing Summer, Autumn, Winter, and Spring. It not only illustrates the deer's habits at different seasons, but shows the changes in its coat throughout the year and the growth and shedding of the antlers.

CHICAGO WINTER BIRDS

BY

COLIN C. SANBORN

Assistant, Division of Birds



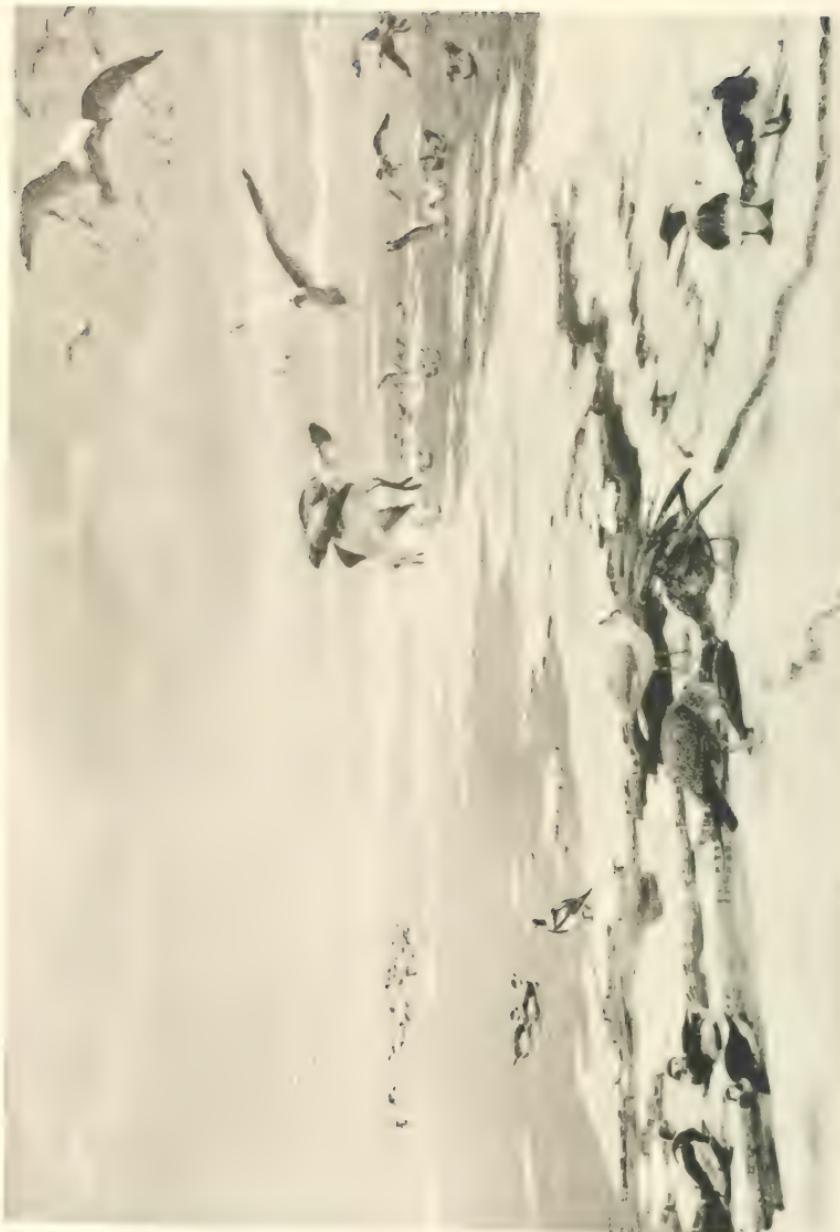
FIELD MUSEUM OF NATURAL HISTORY

CHICAGO

1922

WINTER BIRDS ON LAKE MICHIGAN.

FROM GROUP IN FIELD MUSEUM OF NATURAL HISTORY.



FIELD MUSEUM OF NATURAL HISTORY
DEPARTMENT OF ZOOLOGY
CHICAGO, 1922

LEAFLET

NUMBER 2

Chicago Winter Birds

In the chill days of fall, when the trees begin to drop their leaves, most of the birds that have made this region their summer home, depart for a warmer climate where food is more plentiful. Some, however, find sufficient food here in winter, so remain as residents throughout the year. Others, used to a more rigorous climate, are easily able to withstand our winters, and come down from the north to remain until spring. Still another group is found here only in severe winters when weather conditions farther north interfere with the food supply or when the supply itself is limited, and they are driven into this region in their search for subsistence.

Weather conditions and the character of the vegetation in the vicinity of Chicago are favorable for a variety of birds to spend the winter. The Lake, rarely freezing, provides open water for a number of species of ducks, which subsist mainly on fish at this time of year, and also for the gulls, which are more scavengers than fish eaters. In the city parks are many trees and shrubs whose fruit supplies certain species with food. In the suburbs, many people maintain feeding shelves supplied with suet, nut meats, and other attractive food for birds. As the snow is seldom deep enough to cover all the dried stalks of golden rod, ragweed and other seed-bearing plants, which are plentiful along ditches and field borders, the different sparrows are well provided for. Mice, which are preyed upon by

the hawks and owls, are always abundant in the fields and woods. In the Dune region of northern Indiana, where deep hollows afford the birds protection from the wind and snow, there is a great supply of poison sumach, flowering dogwood, bittersweet and other like fruits, as well as many conifers attractive to Crossbills and Pine Grosbeaks.

With such favorable conditions, then, it is not to be wondered that there are about sixty species of birds that may be found in the vicinity of Chicago during the winter. Let it not be supposed, however, that all sixty can be found every day or even every winter. Birds are not so abundant in winter as at other seasons, and each species stays in the locality best suited to its requirements, so they are often widely separated. Certain species are of a restless nature, and while found in one place today, may be miles away by tomorrow. Moreover, the severity of the winter, affecting their movements, keeps certain species here during mild years and drives others down from the north during cold years.

This paper will take up the different types of country about Chicago, and briefly discuss the species likely to be found in them. Lake Michigan and the ducks found there will first be considered. The best time to observe ducks is when a west wind has blown the loose ice out, leaving a waterway between it and the solid ice masses which extend out from the shore. In this open water, the ducks feed and often come close to the ice for protection from the wind, so that a person hidden in a hollow near the edge of the water has an excellent opportunity to make close observations. There are four ducks that are common in winter, the American Merganser, Red-breasted Merganser, Old Squaw and Golden-eye. They arrive in October and November and leave the last of March or early in

April. The Red-breasted Merganser sometimes stays until late in May. Another species, the Barrow's Golden-eye, closely resembles our common Golden-eye, but is very rarely found here. Only the adult males can be distinguished from the common species, unless in the hand, so many may pass unnoticed. The Harlequin Duck has been reported during the last few years, but is of very rare occurrence. Three scoters, the American, White-winged, and Surf Scoter, have been found at times, but as they generally stay some distance out in the lake they are seldom reported. The only geese still common here are the Canada Geese, and most of these are seen on the wing as they fly between the lake and the cornfields, where they go to feed in the early morning and late evening. They arrive about the middle of October and some flocks stay all winter, leaving in April. The Herring Gull and the Ring-billed Gull are always plentiful along the lake and in the rivers. The former is the larger bird, but it is hard to distinguish the different species except when seen together. They are great scavengers, and where any refuse is being dumped, large flocks will gather. The smallest of our gulls, the Bonaparte's, appears in August and stays until November, some occasionally remaining all winter.

Along the beach in the early part of the winter, until the last of December, Snow Buntings are fairly common. They arrive the last of October and may stay until the first of March, although rarely found after December. Prairie Horned Larks are sometimes found with them. On the more open prairies or in sparsely settled areas, a few Prairie Chickens are making a last stand. They were formerly common in this region, but the cultivation of the fields and shooting have driven them out. A few years ago, a farmer found two nests while plowing and thoughtfully left

a large patch of grass about each one, with the result that all the eggs hatched safely. If everyone would be so considerate, there might be more chickens. Two game birds that have been introduced with marked success are the Pheasant and Hungarian Partridge. They are found in open and brushy fields, and are said to be increasing very encouragingly.

As the hawks and owls prey upon mice in winter, it is about the more open country that they are most common, such as fields and marshes. The Marsh Hawk, a common resident, often winters here, and when on the wing is easily identified by the conspicuous white patch on the rump. The American Rough-legged Hawk appears in October and November and stays about in small numbers until early March. It is a heavy, slow-flying hawk, and often hunts in the early evening after the sun has set. During particularly hard winters, large numbers of Goshawks are apt to appear from the north. They destroy much game and poultry and in consequence many are shot. One Chicago taxidermist received fifteen for mounting during a recent visit of these birds. Snowy Owls also come with the Goshawks, but are less frequent. It is hard to say in what particular locality they are most likely to be found. The last one seen in this region was found in Grant Park near the Museum, by H. L. Stoddard, in November, 1919. The most common owl is the Short-eared, especially during its migration in late October and early November. This bird tries to escape notice by sitting quietly in the grass or cat-tails, and only flies when nearly stepped on.

A very beneficial little bird, catching many mice and also English Sparrows, is the Screech Owl. It is seldom seen, however, for during the day it sleeps in some hollow tree or old woodpecker's nest, only coming out to hunt after the sun has set. It even comes into

the city, where its presence is seldom suspected unless its quavering call is heard. The Sparrow Hawk, a common summer resident, stays about in small numbers during mild winters. During 1921 and 1922, especially, many were reported. Mice and small birds are sometimes found impaled on the thorns of the haw, wild crab and other trees. This is the work of the Northern Shrike or Butcherbird, as it is popularly called, which appears in small numbers in October and stays about until March.

In mild years, a few Meadowlarks usually remain, staying in one locality all winter, about certain favorite fields. The Prairie Horned Lark is a common resident, frequenting open fields and prairies, as its name suggests. It is always very plentiful on golf courses. It nests very early, sometimes in March when snow is still on the ground. In the brushy fields, open woods and along the roads, the Tree Sparrow is always present. It arrives about the middle of October and leaves about the first of May. The Slate-colored Junco, often found with it, arrives in September and spends the winter in small numbers, leaving in April. As the food of these two sparrows consists chiefly of noxious weed seeds, they are very beneficial to agriculture. Three other finches with similar local preferences are the Goldfinch, Redpoll and Pine Siskin, the latter preferring the pine woods. The Goldfinch is a common resident and the Redpoll and Pine Siskin come down from the north in October and stay until April, the Siskins staying, sometimes, until May. The Redpoll is more common and is here every year, while the Siskin is rare in some years. The Holboell's and Hoary Redpolls have been taken here, but are very rare. Two other sparrows, occasionally found in winter, are the Song Sparrow, a summer resident, and the Fox Sparrow, a common migrant. The Song Sparrow has been

noted in ditches and in cat-tails in a marsh in January and February. In mild winters, Fox Sparrows stay about brushy woods and fields. Mr. W. I. Lyon of Waukegan had one about his feeding station from November to late March, the winter of 1921-22.

In woods and along their borders and in orchards, the Hairy and Downy Woodpeckers feed on the larvae of destructive insects and wood-boring beetles, thus greatly helping the farmer in keeping these pests under control. Another resident, the Chickadee, more common in winter, is often found with the Downy. It is a bright, active little bird, very tame and inquisitive, often coming within a few feet of a person. The Hudsonian Chickadee, from the north, is a very rare winter visitant, and there are but few records of its capture here, the last being in 1906. The Brown Creeper, a migrant arriving late in September, frequently remains all winter, leaving the first part of May. It works its way to the top of one tree and then flying to the bottom of another, repeats the performance. The White-breasted Nuthatch is a fairly common winter resident and a rare breeder in this area, and the Red-breasted is, in some years, a common migrant from September to November, when a few will winter. The latter bird is partial to pine trees and sometimes the pines at Beach, Illinois, are fairly alive with them during a heavy migration. Later, they may be seen there in December and January.

As mentioned before, the Dune region in northern Indiana is especially attractive to winter birds, and the following, while also found in other sections, are most common in the Dunes. Two game birds are holding their own fairly well, the Bob-white and Ruffed Grouse. There are four or five coveys of Bob-white about the Dunes which, with protection, ought to increase. A few coveys also may be found southwest of

the city. The Ruffed Grouse is fairly plentiful in the Dunes. It breeds there and appears to be slowly increasing. Since the heavy timber has been cut and the country become more settled, the Great Horned Owl has almost disappeared, but a few, perhaps a dozen pairs, still linger in this region. They breed very early, in late February or early March. Some may still be found in the heavy timber along the Des Plaines River. The Long-eared Owl also appears in small numbers in the Dunes and a few breed there. It is generally found in pine trees. The smallest owl found here, the Saw-whet, was formerly not an uncommon resident, but appears now mostly as a winter visitant, at times fairly common in the Dunes. In years when the acorn crop is especially large, the Red-headed Woodpeckers remain through the winter. They are very plentiful in the Dunes and have been found storing acorns in cracks in trees and under the bark. The Northern Flicker, a common summer resident, winters in the Dunes in small numbers nearly every year. Prior to the fall of 1920, there were but four records of the Arctic Three-toed Woodpecker for the Chicago area. During that fall, however, there was an invasion of these birds from the north, and some sixteen were reported, including a number from the Dune region where they were found well into December. In the pines in deep hollows in the Dunes, Golden-crowned Kinglets generally may be found. Kinglets are common migrants, arriving the last of September, and a few spend the winter, leaving in April. They are usually found in thick pines in winter. A southern bird that is gradually extending its range northward is the Tufted Titmouse. It is now fairly common south and west of the city, but few have been seen north. It probably breeds in the Dune region. The Cardinal is another southern bird

that has become fairly common in the past ten years, until now nearly every town about Chicago has at least a few pairs. They are gradually increasing, and, as they are not only beautiful birds, but also wonderful singers, are more than welcome.

There are three irregular winter visitants which feed on the seeds of pine cones and, therefore, are most apt to be found in regions where conifers are plentiful. The first of these, the Pine Grosbeak, appears about every four or five years. At times it is very shy, difficult of approach and easily frightened, and again may be very tame and fearless. Besides pine seeds, it feeds on the fruits of various shrubs. The American and White-winged Crossbills occur a little more often than the Grosbeaks, the American being the more common of the two. When in flocks, they are very wild and hard to approach, but when only two or three are together, they can almost be caught in the hand. When feeding, which they do both upright or hanging head downward, they are quiet and difficult to see in the pines. The Newfoundland Crossbill, a subspecies of the American, has been taken here only once. The Crossbills are very erratic and many may be seen in a certain spot one day, and on the next, all will have gone. While primarily winterbirds, they have been found here in June and August.

Another species, occurring here intermittently, is the Bohemian Waxwing, which appears in large numbers during some years, generally about the last of November. On the 30th of this month, in 1919, a large flight of these birds was observed at Beach, Illinois. Flocks of fifty to a hundred passed overhead every five or ten minutes, from seven in the morning until noon, a few stopping to feed on the juniper berries. About fifteen hundred passed at that time and spread out over Chicago. Some twenty-five stayed about a moun-

tain-ash tree in Highland Park for a week, until they had eaten all the fruit. Many appeared in Jackson Park and they were found again in February in the Dunes. The Evening Grosbeak, supposedly an irregular winter visitant, has been found in the Dunes every winter for the past ten years by H. L. Stoddard. A few are seen elsewhere at other times, but not so commonly as in the Dunes. A common migrant, the Purple Finch, may be seen about in winter. It is an erratic bird, and no definite place could be named where it might be found regularly. Bronzed Grackles and Robins often pass the winter here, the former generally in the vicinity of some pine grove, and the latter in any protected spot where food can be secured. The "first Robins" are probably birds that have wintered here. Two of our most common winter birds frequent the entire area, the Blue Jay and Crow, although the Jay comes about houses more than the wary Crow.

To those interested in winter birds, a feeding shelf is a great help, as it brings some of the birds close to hand and gives a better opportunity for study. It may often save the lives of many birds when storms have covered the ground with deep snow or coated the trees with ice. Woodpeckers, sparrows, nuthatches, cardinals, jays, chickadees, titmice and occasionally others will patronize it. A feeding shelf is not only a pleasure to the one keeping it, but it is a great benefit to the birds, which certainly deserve some reward for their assistance in keeping in check the many insect pests which are so destructive to trees and shrubs. The Government has published a bulletin on the subject (Farmers' Bulletin, No. 912), which may be secured upon application to the Secretary of Agriculture.

COLIN C. SANBORN,
Assistant, Division of Birds.

CLASSIFIED LIST OF CHICAGO WINTER BIRDS RESIDENTS

Herring Gull	Northern Flicker
(<i>Larus argentatus</i>)	(<i>Colaptes a. luteus</i>)
Ring-billed Gull	Prairie Horned Lark
(<i>Larus delawarensis</i>)	(<i>Otocoris a. praticola</i>)
Bob-white	Blue Jay
(<i>Colinus v. virginianus</i>)	(<i>Cyanocitta c. cristata</i>)
Ruffed Grouse	Crow
(<i>Bonasa u. umbellus</i>)	(<i>Corvus b. brachyrhynchos</i>)
Prairie Chicken	Meadowlark
(<i>Tympanuchus americanus</i>)	(<i>Sturnella m. magna</i>)
Marsh Hawk	Bronzed Grackle
(<i>Circus hudsonius</i>)	(<i>Quiscalus q. aceneus</i>)
Sparrow Hawk	Goldfinch
(<i>Certhneis s. sparveria</i>)	(<i>Astragalinus t. tristis</i>)
Long-eared Owl	Song Sparrow
(<i>Asio wilsonianus</i>)	(<i>Melospiza m. melodia</i>)
Screech Owl	Cardinal
(<i>Otus a. nigerius</i>)	(<i>Cardinalis c. cardinalis</i>)
Great-horned Owl	White-breasted Nuthatch
(<i>Bubo v. virginianus</i>)	(<i>Sitta c. carolinensis</i>)
Hairy Woodpecker	Tufted Titmouse
(<i>Dryobates v. villosus</i>)	(<i>Bacolophus bicolor</i>)
Downy Woodpecker	Chickadee
(<i>Dryobates p. medianus</i>)	(<i>Penthestes a. atricapillus</i>)
Red-headed Woodpecker	Robin
(<i>Melanerpes erythrocephalus</i>)	(<i>Planesticus m. migratorius</i>)

COMMON WINTER VISITANTS

American Merganser	Short-eared Owl
(<i>Mergus americanus</i>)	(<i>Asio flammeus</i>)
Red-breasted Merganser	Saw-whet Owl
(<i>Mergus serrator</i>)	(<i>Cryptoglaux a. acadica</i>)
Golden-eye	Redpoll
(<i>Glaucionetta c. americana</i>)	(<i>Acanthis t. linaria</i>)
Old-squaw	Pine Siskin
(<i>Clangula hyemalis</i>)	(<i>Spinus pinus</i>)
Canada Goose	Snow Bunting
(<i>Branta c. canadensis</i>)	(<i>Plectrophenax n. nivalis</i>)
Rough-legged Hawk	Tree Sparrow
(<i>Tribbletoe lagopus sancti-johannis</i>)	(<i>Spizella m. monticola</i>)

Slate-colored Junco
(Junco h. hyemalis)

Northern Shrike
(Lanius borealis)

IRREGULAR WINTER VISITANTS

Scoter	Evening Grosbeak
(<i>Oidemia americana</i>)	(<i>Hesperiphona v. vespertina</i>)
White-winged Scoter	Pine Grosbeak
(<i>Oidemia deglandi</i>)	(<i>Pinicola e. leucura</i>)
Surf Scoter	Crossbill
(<i>Oidemia perspicillata</i>)	(<i>Loxia c. minor</i>)
Goshawk	White-winged Crossbill
(<i>Astur a. atricapillus</i>)	(<i>Loxia leucoptera</i>)
Snowy Owl	Bohemian Waxwing
(<i>Nyctea nyctea</i>)	(<i>Bombycilla garrula</i>)

RARE WINTER VISITANTS

Barrow's Golden-eye	Hoary Redpoll
(<i>Glaucionetta islandica</i>)	(<i>Acanthis h. exilipes</i>)
Harlequin Duck	Holboell's Redpoll
(<i>Histrionicus histrionicus</i>)	(<i>Acanthis l. holboelli</i>)
Arctic Three-toed Woodpecker	Hudsonian Chickadee
(<i>Picoides arcticus</i>)	(<i>Penthestes h. hudsonicus</i>)
	Newfoundland Crossbill
	(<i>Loxia c. percna</i>)

MIGRANTS THAT SOMETIMES WINTER

Bonaparte's Gull	Brown Creeper
(<i>Larus philadelphia</i>)	(<i>Certhia f. americana</i>)
Purple Finch	Red-breasted Nuthatch
(<i>Carpodacus p. purpureus</i>)	(<i>Sitta canadensis</i>)
Fox Sparrow	Golden-crowned Kinglet
(<i>Passerella i. iliaca</i>)	(<i>Regulus s. satrapa</i>)

INTRODUCED RESIDENTS

English Sparrow	Hungarian Partridge
(<i>Passer domesticus</i>)	(<i>Perdix perdix</i>)
	Ring-necked Pheasant
	(<i>Phasianus colchicus</i>)

Winter birds are shown in the exhibits of the Field Museum in two habitat groups, in Hall 20. One of these represents the icy shore of Lake Michigan during cold weather, and shows three species of ducks, Old-squaws, Red-breasted Mergansers, and a Surf Scoter, and also adult and immature Herring Gulls. The other group represents a brushy woodland near Chicago, and shows the Hairy Woodpecker, White-breasted Nuthatch, Screech Owl, Crow, Chickadee, Prairie Horned Lark, Snow Bunting, Blue Jay, Northern Shrike, and an English Sparrow and Redpoll which have been caught by the Shrike.

THE AMERICAN ALLIGATOR

BY

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Assistant Curator of Reptiles and Amphibians



FIELD MUSEUM OF NATURAL HISTORY
CHICAGO
1922

THE AMERICAN ALLIGATOR.
FROM A MOUNTED SPECIMEN, PRESENTED BY MR. HARRY THURSTON, IN FIELD MUSEUM OF NATURAL HISTORY.



FIELD MUSEUM OF NATURAL HISTORY
DEPARTMENT OF ZOOLOGY
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NUMBER 3

The American Alligator

The alligator is one of the best known of North American animals. Even in the northern states, its name and appearance are familiar to most people, whether through a picture post-card from a tourist friend in Florida, the sight of a souvenir baby "gator" or from a stuffed museum specimen. The name "alligator" is a corruption of the Spanish "El Lagarto," which means "the lizard." This term is still applied in some Spanish American countries to the crocodiles and caimans.

The American alligator is an excellent example of the group of reptiles known technically as the Crocodilia. This group includes the gavials, crocodiles, alligators, and caimans, and a few related forms which have no common English names. The gavial (genus *Gavialis*), of which there is only one form or species, has an extremely long and slender snout, with a large number of slender, projecting teeth. The crocodiles (genus *Crocodylus*) include several species with more or less tapering snouts and with fewer teeth.

Alligators and most caimans have broad shovel-shaped snouts, and differ from crocodiles in the position of the fourth lower tooth.

These forms may be called, collectively, "crocodilians." In all, there are twenty known living species and many more fossil forms. They are often of great size, ugly and vicious in appearance, and wholly carnivorous. They inhabit fresh water swamps, lakes

and rivers in tropical or subtropical countries, though two species, the Nile Crocodile (which is found throughout Africa), and the East Indian Crocodile, are known to swim boldly out to sea. These two species are also notable as the most seriously dangerous to human beings. They are all excellent and powerful swimmers and secure their food either in the water or from the neighboring banks. They are by no means exclusively aquatic, however, the true crocodiles, especially, being capable of active motion on land. All come ashore to sun themselves and to deposit their eggs. In size, the crocodilians are the largest of living reptiles. Some of the existing forms reach an occasional length of thirty feet, while the largest fossil forms are estimated at about fifty feet.

The American alligator with a maximum adult size of about sixteen feet is intermediate between these monsters and the smallest forms. One of the South American caimans is not known to reach a length of more than four feet.

Superficially, crocodiles resemble gigantic lizards, but with the exception of the general characters common to all reptiles, they are really widely distinct from lizards. By their large size they remind us of extinct dinosaurs and examination of their skulls and skeletons shows that they are really more closely allied to the dinosaurs than to the other groups of living reptiles (turtles, lizards and snakes, and the *Sphenodon* of New Zealand).

The fossil history of the Crocodilia is of great interest. Their mode of life insures the preservation of their remains more frequently than is the case with more terrestrial animals, with the result that the record of their ancestry is rather better known than that of most groups of reptiles. They reached their greatest development toward the close of the great

age of reptiles, the direct ancestors of modern crocodiles and alligators being contemporaries of the dinosaurs, the flying reptiles, and the gigantic sea lizards of the late Cretaceous period. Just as might be expected from their semi-aquatic habits, we find that some of these ancestral forms had taken to marine life and become almost wholly aquatic, perhaps coming ashore only for egg-laying.

There is great variation among the twenty living species of crocodilians in the length and breadth of the snout. The greatest degree of elongation of

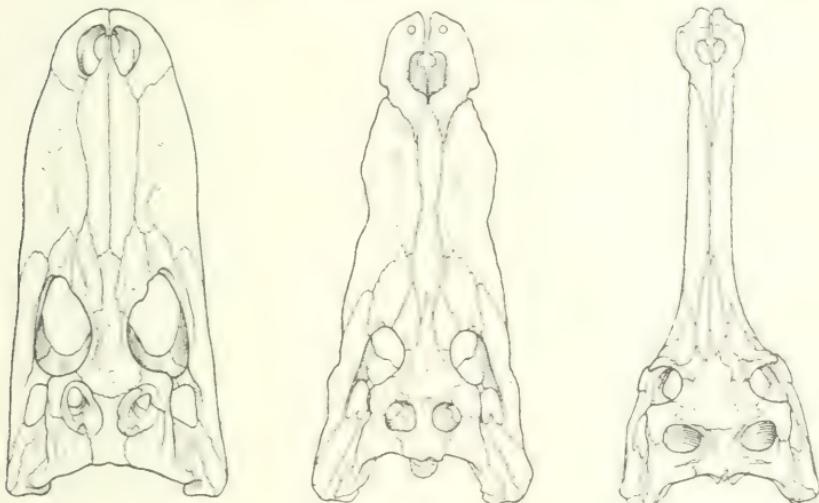


Fig 1.

Skulls of Alligator (*Alligator mississippiensis*) Crocodile (*Crocodylus americanus*), and Gavial (*Gavialis gangeticus*), from left to right.

the snout is shown by the Indian gavial (*Gavialis gangeticus*.) The Indian name, "gharial," of which gavial is a corruption, means fish eater. Fish do in fact form the chief part of its food. They are caught by sudden sidewise lunges of the head and neck. In this movement a long slender snout offers much less resistance to the water than a broad one. The frequent tendency to elongation of the snout in other

crocodilians may be ascribed to similar habits and a similar need for mechanical efficiency. In the living forms (of the genus *Crocodylus*) this elongate snout is developed independently by three species, one in Australia, one in South America, and one in Central Africa. This is an example of what is called parallel evolution which is usually found in structures, like the slender snouts in question, definitely adapted to some special use. (Fig. 1).

How to distinguish an alligator from a crocodile is a question frequently asked. The greater breadth of snout which characterizes the alligator is illustrated above (in Fig. 1). The fourth lower tooth which is enlarged and fang-like in all crocodiles, fits into a pit inside the margin of the upper jaw in alligators and caimans, while in crocodiles it fits into a notch at the side of the upper jaw. From a side view, then, with the mouth closed, this enlarged tooth is concealed in alligators and caimans and visible in crocodiles. (Fig. 2). Alligators are distinguished



Fig. 2.

Side view of head of young American Alligator and Crocodile. Note the exposed lower tooth in the Crocodile.

by a special bridge of bone dividing the nasal opening of the skull, which is absent in caimans and crocodiles.

The appearance of the American alligator is familiar to everyone. Alligators are probably adult at a length of about eight feet. They continue to grow, however, after reaching this size, so that very old specimens reach much larger dimensions. The largest recorded size may be placed at about fifteen feet, but even twelve-foot individuals are now ex-

tremely rare, owing to the destruction of the large specimens for their hides. Young alligators are dark brown or black with bright yellow cross-bands. The lighter markings become less and less distinct with age, and very old specimens are a dull dark gray or black. The large, regularly arranged, plate-like scales on the back are underlain by plates of bone in the skin. These bony plates are absent in the skin of the belly, which is, therefore, more valuable for leather. Caimans and the African dwarf crocodile (*Osteolaemus*), have bony plates in the skin of the underparts, and in the caimans these plates are closely joined on the back and belly. Some fossil forms had an even more complete armor. The teeth are formidable. They are placed in regular sockets in the jaw-bones and are regularly shed, being replaced by new teeth growing into the hollow bases of the old ones. The head is remarkable for the nearly complete absence of flesh on its outer surface. There are no fleshy lips. The skin is so closely attached to the bone that it is impossible to detach it without destroying it.

There are many adaptations to life in the water in the alligator's body. The hind feet are fully webbed, the front feet slightly webbed. In active swimming, however, the legs are held at the sides and the body is propelled by sidewise strokes of the powerful tail. The tail is strongly flattened from side to side and the ridge of scales along its upper edge increases the propelling surface. The form of the head is such that the alligator can float at the surface of the water with only eyes and nostrils exposed. The nostrils can be closed by a valve-like flap of skin when it submerges. A similar arrangement of eyes and nostrils is found in many other animals that live in the water, the hippopotamus being a notable example among mammals. A complicated apparatus provides for the opening of the mouth at the surface of the

water where food is usually seized, without interfering with breathing. A valve in the throat closes the gullet while a bony palate separates the air chambers in the head from the mouth, the internal opening of the nostrils being at the very base of the skull instead of in the roof of the mouth, as in other reptiles. The gradual development of this bony palate can be traced in the fossil ancestry of the Crocodilia, and its progressive adaptation to special conditions is an impressive example of evolutionary change.

The American Alligator is found from the Rio Grande in Texas, in the streams and bayous of the

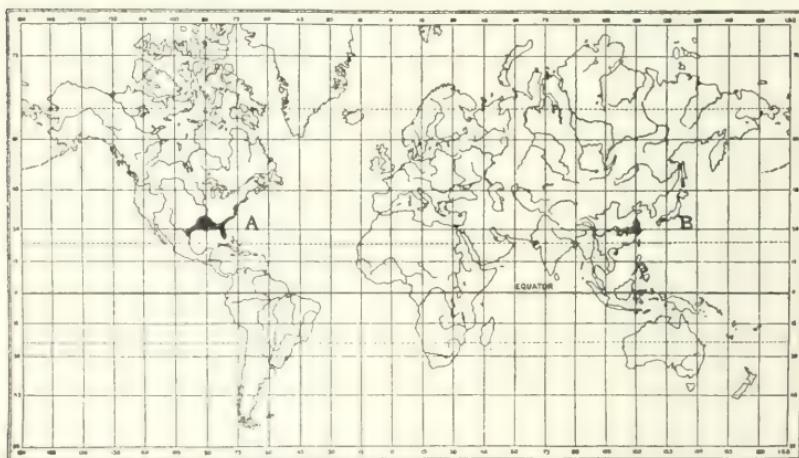


Fig. 3.

The distribution of living Alligators is shown in black on the map. The American Alligator (A) is found in southeastern North America; the Chinese Alligator (B), in eastern China.

Gulf coastal plain, throughout Florida, and in the Atlantic coastal plain north to North Carolina. In the Mississippi, it ranges northward as far as the Red River. In former times it was abundant throughout its range, but hunting for skins and sport has made it scarce nearly everywhere. Possibly its most important remaining strongholds are the Everglades of

Florida and the Okefinokee Swamp of southern Georgia.

Strangely enough, the only crocodilian which is closely enough related to the American alligator to be placed in the same genus by zoologists, is found in the Yang-tze River of eastern China. This is the small Chinese alligator (*Alligator sinensis*). This is less surprising when it is remembered that many of the most striking forms of animal and plant life in eastern North America have their nearest living relatives in China. This fact is illustrated by the tulip and sassafras among trees, the spoonbill sturgeon among fishes, and a number of common snakes and lizards besides the alligator, among reptiles.

The food of the alligator consists largely of fish. The young probably eat crawfishes and other small animals as well, and as they increase in size, a few mammals that come to the water and a few water-birds are added to the diet. Large alligators are able to capture animals as large as a deer, dragging them under water to drown and tearing the victim to pieces, often with the aid of another alligator, before swallowing. The diet of even the largest specimens probably consists chiefly of fish. The country inhabited by alligators is river-bottom land subject to overflow. During the spring floods, large numbers of fish find their way into the water-holes which are unconnected with the river at its normal level. As the season progresses and these holes dry out, the fish become more and more crowded and fall an easy prey to their enemies, among which the alligator is one of the most important, at least where it still occurs.

Human beings are rarely attacked by alligators. Even where large specimens are found, the hunters and natives most familiar with the habits of "gators" have no fear of them and bathe in the waters in which they live. In this respect, alligators and caimans dif-

fer from crocodiles, which are much more active and dangerous animals, although the American crocodile is less to be feared than the African or East Indian species.

Stones and pine knots are frequently found in the stomachs of alligators. Whether or not they are of any use in the digestion of food, like the pebbles in the gizzard of the bird, is unknown. Many extinct reptiles are known to have made similar collections of "stomach stones." The explanation of the hunters in the south, that they prevent the walls of the otherwise empty stomach from adhering during hibernation, is of course fanciful. Nearly everywhere in the United States, alligators hibernate for three or four months during the coldest part of the year. They bury themselves in the mud of the water-holes or swamps in which they live, and remain dormant until the approach of spring brings them out. In some tropical countries where the climate becomes too dry for the native crocodilians, they "aestivate" during a few months of the hottest and driest season, burying themselves in mud in the same way.

After emergence from their winter sleep, alligators feed for a time before the beginning of the breeding season, which occupies the late spring months. During the mating season the bellowing of the males is heard, and from the frequent mutilations of large specimens, it is presumed that fighting takes place between them at this time. The voices may be heard at a distance of a mile or more. A strong musky odor is discharged from the scent-glands at the sides of the throat when they are excited.

The female alligator prepares a nest for her eggs by biting off and carrying together a mass of vegetation such as grass, cat-tails and rushes. In this way a rounded or conical pile of trash is built up, not unlike a muskrat's nest, but placed at the edge or in the

neighborhood of the water. The pile is compacted by crawling back and forth over it. In this nest, the eggs, which average about thirty in number, are laid. The time of laying corresponds closely to the month of June, in Florida at least, and the hatching process occupies about eight weeks. The moist vegetation of the nest serves to prevent the drying out of the eggs and also protects them from the daily fluctuation in temperature. Possibly the heat from the decomposition of the materials of the nest aids the development of the eggs.

The mother alligator is said to guard the nest or at least to remain in its neighborhood during the development of the eggs, and at the time of hatching, she is supposed to assist the escape of the young by opening the nest. Unless this is the case, it is difficult to see how the young can force their way out, the mass of vegetation around the eggs having become very compact during the intervening time. There are no direct observations, of this habit, known to the writer. It is made very probable, however, by the existance of similar habits in the South American caimans and in the Nile Crocodile. It is well established that the latter animal digs the eggs out of the sand in which they are laid when the young are about to hatch, being notified at the proper time by the loud calling of the young crocodiles within the eggs, whose voices may be heard at a distance of several yards. Unhatched alligators also are able to make themselves heard at a considerable distance.

The newly hatched young are about eight inches long, while the average egg is about three inches in length. Their growth is fairly rapid. Specimens raised at the New York Zoological Society's Reptile House reached a length of five and a half feet, and a weight of fifty pounds, at the age of five years. Statements as to the extremely slow growth of alligators

are based on stunted specimens, kept in water that is too cold for them, and insufficiently fed. They are able to live for a long time without food, but naturally cannot be expected to grow under unfavorable conditions.

The use of alligator hides for leather has had a curious history. Not much use of alligator leather was made until 1855, when shoes and other objects made from it were in fashion for a brief season, and a few thousand skins were prepared. The leather went out of fashion again in a short time, but during the Civil War, the shortage of leather in the southern states led to a renewed demand for alligator skins, this time chiefly for boots and shoes. This use came to an end with the war, as the leather is really unsuited for shoes. The respite for the alligators, however, was a temporary one, for the leather again became fashionable about 1896, for use in fancy slippers and boots, travelling bags, pocketbooks, music rolls, etc. Since that time, the demand for alligator skins has been a steady one. It has been found that the skin of the back, the so-called "horn back", which was formerly discarded, can be tanned quite as well as that of the lower parts.

The number of skins of crocodilians used in the United States, as estimated by the U. S. Fish Commission, was about 280,000, in 1902. This may be considered an average figure for the preceding period, but with the increasing scarcity of alligators, it has probably decreased considerably since then. Of this large number of skins, about 120,000 were those of American alligators, the remainder being chiefly crocodile skins from Mexico and Central America.

Dr. A. H. Wright and W. D. Funkhouser, in their notes on the alligator in the Okefenokee Swamp, give a good account of what is probably the commonest method of hunting. They write:

"The methods of hunting the alligator, as prac-

ticed by the Lees and other inhabitants of the region, consist mainly of going out at night in small boats and locating the animals by means of a lamp fastened to the head of one hunter in the bow of the boat. Another hunter in the stern paddles or poles and uses the sharp end of the push pole to 'stick' the body after the animal has been shot and has sunk to the bottom. According to these hunters, who every year take out a large number of skins, the eyes of the small alligators appear red by the light thus used, while those of the large specimens are yellow. The hunter carrying the light swings his head from side to side through an arc of 180 degrees, and when an alligator is sighted, shoots it by the light of the lamp on his head. The common supposition that the skin of an alligator will turn the bullet of a gun is, of course, unfounded. Since, however, only the head of the animal is usually exposed when it is in the water, they are commonly shot through the eyes. The hunters generally use a shotgun loaded with buckshot. That a large number of alligators are annually secured in this manner is evidenced by the fact that the fields of the Lees are strewn with the skeletons and dorsal strips of skin which have been thrown away after each expedition. Only the ventral part of the skin is saved, the upper portions being too thick and spiny to admit of the primitive methods of tanning, and therefore, the crest and dorsal scales are not retained."

Alligators were formerly extremely numerous throughout their range, and their sluggish forms, often mistaken for stranded logs, were a familiar sight on the banks of every body of water in the South. Steady hunting for their skins during the past sixty years, the robbing of their nests for eggs, the capture of large numbers of the newly hatched young for "souvenirs", and wanton slaughter by so-called sportsmen, have decimated the species to such an extent that

few places are now left where it can still be said to be abundant. Perhaps the most important of these refuges are parts of the Florida Everglades and the great Okefinokee Swamp of southern Georgia. In these places, at least for the present, the alligator is probably safe from extinction. The great interest that the animal has for naturalists and its importance as one of the most characteristic North American animals, make its growing scarcity a matter of regret to all nature lovers.

The fact that the alligator is of such great interest to tourists (whether naturalists or not), may prove to be an important factor in saving the species from extinction. They seem to breed freely in captivity. The first "alligator farm" was established in 1895, and there are now at least eight "farms" in the United States. It would not be practicable to raise alligators for their skins alone, on account of their relatively slow rate of growth, but when the sale of baby alligators to tourists, the sale of larger specimens to zoological parks, and possibly an additional fee for visitors to the establishment are combined, the raising of alligators becomes a practical business.

The capture of wild alligators, alive, is by no means an easy process. It is effected by means of noosing, or with a large hook placed on the end of a pole which is inserted into the alligator's under-water retreat. The first farms where alligators were kept, were established primarily to accustom them to captivity and to taking food, preparatory to shipping them to zoological gardens, aquariums, and circuses. The demand for baby alligators for souvenirs led to the practice of hatching the eggs taken from the nests of wild alligators in incubators. This may be done by maintaining them at a temperature of 80 degrees F., and moistening them daily to prevent drying. Alligator

farms, however, proved to be a source of attraction for visitors, and at the larger of the modern establishments, the number of alligators on hand runs up to several thousand, of which probably a few hundred are of breeding age. They are kept in enclosures of wire netting, with concrete lined pools or streams. They must be assorted somewhat according to size, and extremely large individuals are given separate pens. There seems to be no authentic account of their breeding habits in captivity, and observations on this point would be of great interest. Alligator farming appears to be a successful enterprise, for in 1921, in addition to adult specimens sold to zoological parks, a single farm in Jacksonville, Florida, sold over ten thousand baby alligators.

KARL P. SCHMIDT,
Assistant Curator of Reptiles and Amphibians.

Books and articles containing information about alligators.

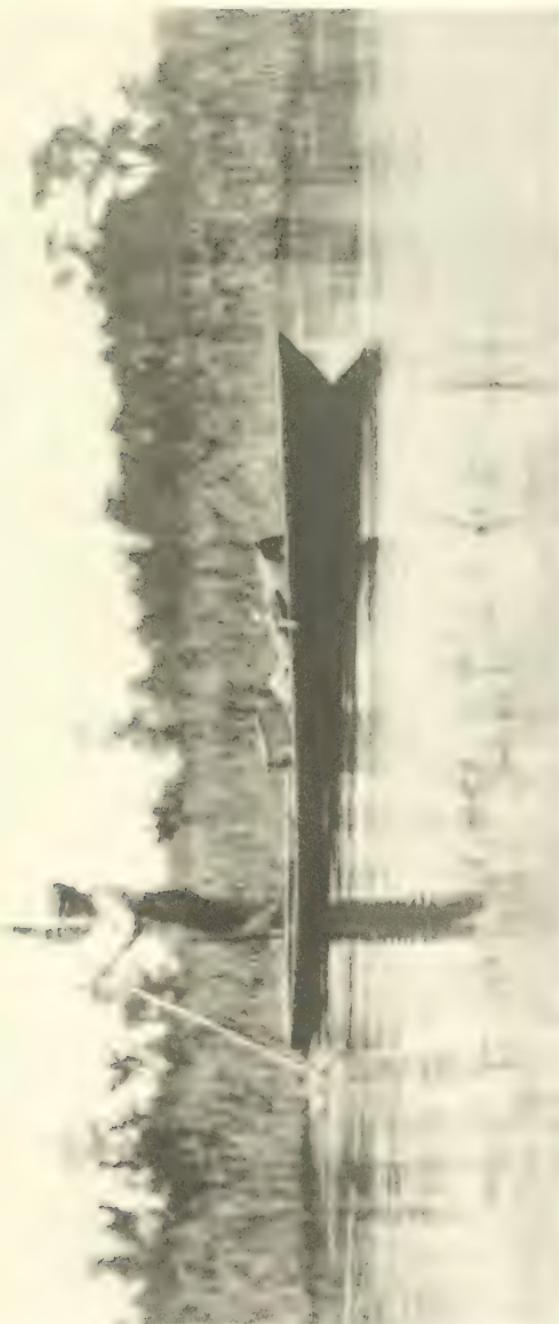
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XI, 1893, pp. 343-45)
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(Chicago, 1914)
- WRIGHT, A. H. and
FUNKHAUSER, W. D.A Biological Reconnaissance of the
Okefenokee Swamp in Georgia.
(Proc. Acad. Nat. Sci. Phila., 1915,
pp. 136-39)

Alligators and their allies are represented in the Field Museum by a large mounted alligator, figured as the frontispiece to this leaflet, a mounted gavial, and a caiman. In the hall of osteology are complete skeletons of the American Alligator, American crocodile and the gavial.

A TYPICAL ALLIGATOR HOLE IN THE OKEFINOKEE SWAMP.

"JOBING OR JABBING A 'GATOR.'

PHOTOGRAPH BY MR. FRANCIS HARPER, LOANED BY DR. ALBERT H. WRIGHT.



THE PERIODICAL CICADA

BY

WM. J. GERHARD

Associate Curator of Insects



FIELD MUSEUM OF NATURAL HISTORY

CHICAGO

1923



THE PERIODICAL CICADA.

FROM AN EXHIBIT IN FIELD MUSEUM OF NATURAL HISTORY, SHOWING THE VARIOUS STAGES OF THE INSECT AND THE INJURIOUS EGG-LAYING HABITS OF THE FEMALES.

FIELD MUSEUM OF NATURAL HISTORY
DEPARTMENT OF ZOOLOGY
CHICAGO, 1923

LEAFLET

NUMBER 4

The Periodical Cicada

The Periodical or Seventeen-year Cicada, commonly but improperly called the "seventeen-year locust," is one of the most noteworthy insects found in North America. Its sudden appearance at intervals in large numbers in different parts of the eastern United States, the indescribable din caused by the multitude of singing males, and the conspicuous evidence of the damage the females do to deciduous trees, invariably arouse widespread attention and much fear concerning its destructive habits.

The Periodical Cicada is a true bug and, like the other members of the order Hemiptera, has a jointed beak fitted for piercing the tissue of plants. The name locust, so commonly applied to it, is improper, because almost since the beginning of history it has been used to designate wholly different insects, namely, grasshoppers, which have biting mouth-parts and which are not closely related to cicadas. The use of the same name for two dissimilar insects, no doubt, is the result of confusing the cicadas with the devastating locusts of the old world and the destructive locusts or grasshoppers of the United States.

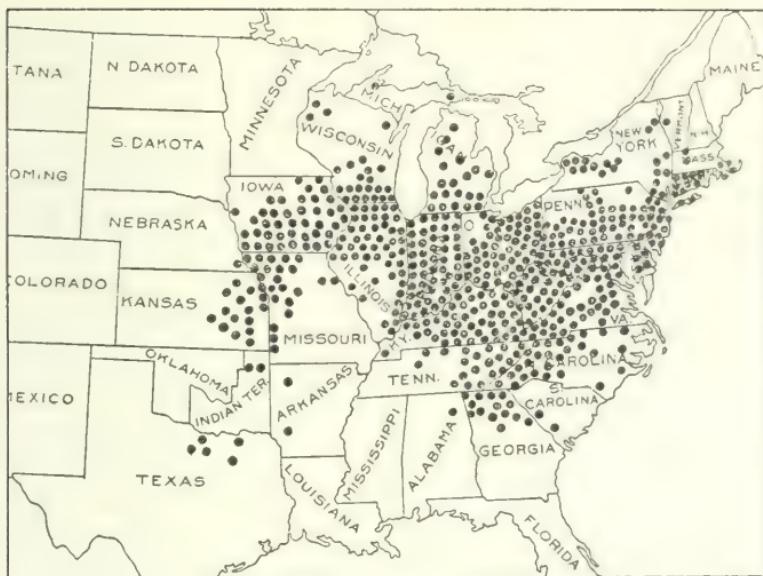
Not only is this insect noteworthy on account of its periodic appearance in immense hordes, but it is remarkable for the extraordinary duration of its life in the larval and pupal stages. In the Northern States its immature stages extend over a period of seventeen years; in the South, thirteen years are

required for its underground existence. It is the only insect that is known to live for so long a period. The sound-producing organs of the adult male are likewise wholly different from those of other insects, in no way resembling the stridulating apparatus of grasshoppers, katydids and crickets.

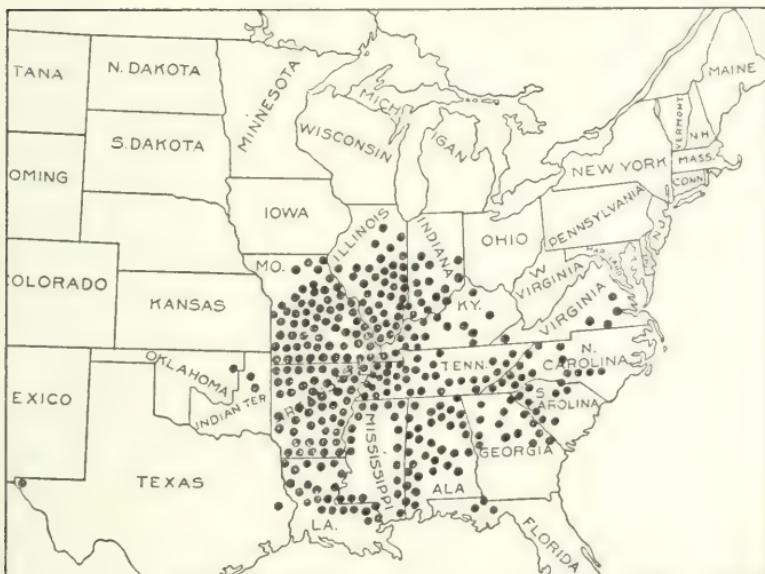
Like most insects, the Periodical Cicada passes through four stages during its life cycle, namely, the egg, larval, pupal and adult stages. Although some of the facts of the life-history were known to the early colonists, it was only during the latter half of the last century that much progress was made in solving many of the problems concerning this interesting cicada. Thus, for a long time it was difficult to account for the appearance of various broods in different sections of the country at intervals shorter than the customary seventeen-year period. The explanation became simple when it was ascertained that there were two races of this insect, one in the Northern States requiring seventeen years for its life cycle, a southern one developing through all of its stages in thirteen years.

On account of the difference in the duration of the life of the northern and southern races, at one time it was thought that there were two species of the Periodical Cicada in America. For this reason different specific names were assigned to them. A name was also proposed for the small, dwarfed individuals that are found among nearly every brood. But as no constant, structural characters have been found to separate the three so-called species, entomologists now consider them to be one species, which they designate as *Tibicina septendecim*, with a southern race, *tredecim*, and a small form, *cassini*.

By means of the many, scattered notes and records, extending back over two hundred years, and the more



Distribution of the broods of the 17-year race of the
Periodical Cicada (after Marlatt).



Distribution of the broods of the 13-year race of the
Periodical Cicada (after Marlatt).

recent, careful observations, it has become possible to trace out thirty broods of the Periodical Cicada. Seventeen broods belong to the northern race; thirteen to the southern. These broods vary greatly in the number of individuals and in the range of their distribution. For example, Brood XI (1920) is very small and appears only in a few sections of Massachusetts and Connecticut, whereas Brood X (1919) is recorded from at least fourteen states, in four of which, namely, Indiana, Ohio, Maryland and southeastern Pennsylvania, it appears in dense swarms. Northern Illinois is within the range of only one large or dense brood, and that is the rather compact Brood XIII, which was so much in evidence during the summer of 1922. With the exception of a few records of individuals in some other states, this brood is distributed over the northern half of Illinois, eastern Iowa, southern Wisconsin and Michigan and northwestern Indiana.

The two maps on the preceding page indicate the distribution of all the broods of the two races. It will be noted that the range of the two races overlaps for a short distance, particularly in southern Missouri, Kentucky, Tennessee, Illinois and Indiana. If the difference in the duration of the immature stages of the two races were wholly due to climatic conditions, it would be natural to expect to find a gradual decrease in the time of development of the northern race as it approaches the northern limits of the southern race. This, however, is not the case. Seemingly the time of development, while no doubt originally influenced by climatic conditions, has become fixed for the species or race as a whole and is now not permanently modified by slight differences in temperature. That the duration of the life of this cicada is sometimes either accelerated or retarded is quite evident, for not infrequently

a few adults emerge a year before the main brood is due, or they may appear a year later.

To account for the existence of the various broods today, the plausible theory has been advanced that originally, many centuries ago, there was but one brood for each of the two races and that they appeared throughout their entire range once every seventeen or thirteen years. But as accelerated or belated individuals increased in number, extended their range and resumed their normal life cycle, there were started the various broods that are now recognized. According to this hypothesis, if the breeding places do not become too limited and no other detrimental factors arise, the different broods will increase to such an extent in the distant future that this insect will appear every year throughout its entire range.

The newly hatched larvæ, or young, of the Periodical Cicada are pale, minute, active creatures with thick forelegs well-fitted for digging and a jointed beak well-suited for piercing small roots. On emerging from the egg, which will be described later, the young drop lightly to the ground and work their way into the soil for a short distance. Near some rootlet each larva encloses itself in a little, isolated, earthen cell which is enlarged as the young increases in size. It is not probable that they move about in the ground for any great distance, but just how they really pass this long, dark period of their life is not known and obviously is difficult to ascertain. Since their cells are nearly always found in close contact to a root or rootlet, it is believed that the immature cicadas feed mainly upon the juices of small roots. The depth to which the larvæ burrow varies from six to twenty-four inches. There are, however, records of some that were found four feet or more beneath the surface of the soil. During their long, subterranean existence

they grow slowly and moult or shed their skin at intervals of several years. Some time after the fourth moult, when the larvæ (of the northern race) are about twelve years old, they change into the first of their two pupal stages.

The pupæ of the Periodical Cicada, unlike those of the majority of insects, rather closely resemble the larvæ. They likewise are quite active and continue to feed upon the juices of roots. Early in the spring, or during the latter part of April, a few months less than seventeen years after the young of the northern race began their subterranean life, the pupæ, seemingly all of them at the same time, burrow upward toward the surface of the ground. At first the exit burrows or cells may end just below the surface, under logs, stones, chips, or leaves; but under certain conditions the pupæ erect tube-like chimneys or turrets of clay that extend from two to six inches above the ground.

An astonishingly large number of larvæ and finally pupæ sometimes inhabit a limited area of the soil. As many as twenty-five chimneys or turrets have been found on one square foot of ground, and nine thousand burrow exits have been counted under one tree.

The exodus from their burrows occurs generally after sundown during the latter part of May and the fore part of June. During one evening myriads of pupæ, as if impelled by an irresistible force, leave their burrows and turrets and climb up on any nearby object. Some crawl up on plants less than a foot in height, while others may ascend trees for a distance of fifteen or more feet. On reaching a favorable spot, they rest quietly for a short period, their thick, front legs clinging tightly to their support. Shortly after it has become dark, the interesting transformation begins. A longitudinal slit first appears along

the middle of the forepart of the pupa's back. This opening gradually widens as the pale adult slowly emerges and leaves the empty pupal skin attached to a leaf, twig or branch.

The freshly emerged adults are rather ghostly creatures, soft, flabby, creamy white in color, with reddish compound eyes and two, black, rectangular spots on their back just behind the head. At first the wings are merely little, wrinkled, whitish pads with an orange tinge at their base, but they soon expand to their final size. The entire body then begins to harden and to assume the characteristic color of the species. A few hours after sunrise on the morning following their transformation, the adult cicadas are ready to commence their short but active career, lasting only from four to six weeks.

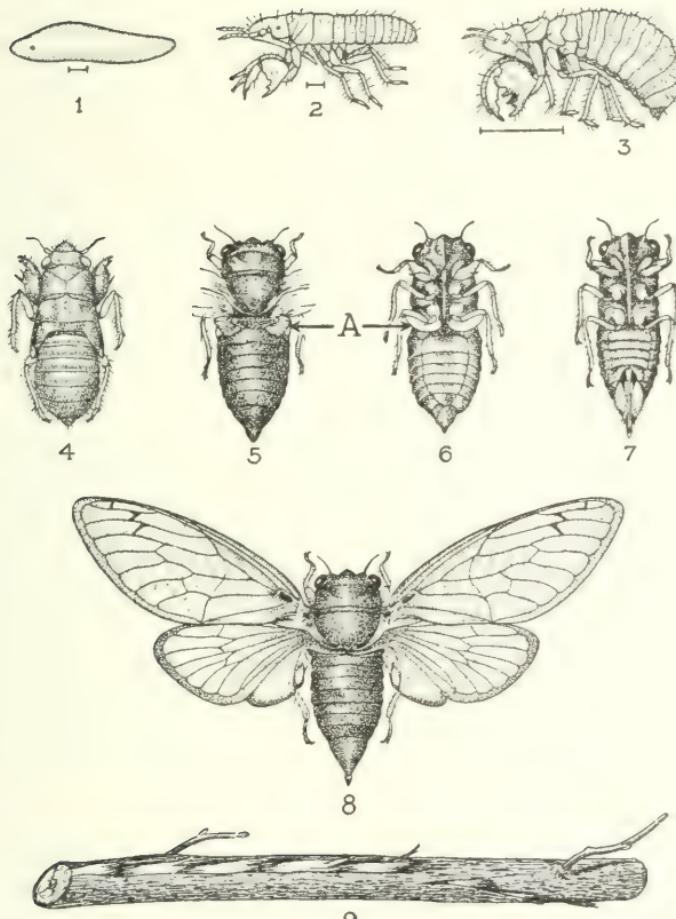
Until a comparatively recent date it was believed that no food was taken by the Periodical Cicada in the adult stage. It is now known, however, that it does feed upon the sap of trees, the branches of which it pierces by means of its beak. Whether the taking of food is really essential for mating and egg-laying is still an open question. For obtaining liquid nourishment its mouth-parts are well fitted. Instead of having biting jaws, it possesses a jointed, beak-like lower lip which encloses fine, elongated, stiff, piercing organs that, with their beak-like sheath, convey the sap to the mouth cavity. Under favorable conditions, this insect could readily pierce the human skin by means of its beak, but apparently it rarely or never attempts to protect itself in such a manner.

The egg-laying habits of this cicada are of considerable interest, and to them is due most of the damage caused by this insect. The female inserts her eggs in the twigs and branches of trees by means of a strong, curved ovipositor which extends from the

underside of the abdomen. The main part of the ovipositor consists of three, horny pieces, two of which are serrated and spear-shaped at the tip, and by a backward and forward movement are able to make a series of punctures in hard wood. Despite a belief to the contrary, the ovipositor is not a sting, and it is doubtful whether it is ever used as a means of defense.

The eggs of the Periodical Cicada are whitish, cylindrical and about one-twelfth of an inch in length. They are inserted just below the surface and are inclined forward at an angle of 45 degrees. With her ovipositor the female makes a series of punctures, generally on the under side of the twig, about half an inch in length, and in them she then lays a longitudinal row of eggs in pairs. Without changing her position on the twig, she makes another series of punctures along side of the first, so that finally each egg nest in the twig consists of two more or less parallel rows of eggs, from ten to eighteen in number and separated by a thin partition. Beginning toward the base of the twig, which commonly is one of the previous year's growth, she works toward the tip, or occasionally toward the base. Sometimes the egg nests are so close together that they appear to be continuous. One twig after another is supposed to be pierced in the manner described until the female has laid her batch of eggs, which may number from two to six hundred.

The eggs are laid in a large variety of trees, bushes, and sometimes in herbaceous plants. Oak trees, either young or old, seem to be preferred, possibly because in most woodland tracts they predominate, and, therefore, are the most accessible. Pine trees appear to be exempt, the gummy sap exuding from the punctures, no doubt, being detrimental to the hatching of the eggs.



Carl F. Grentemann.

- | | |
|--|--|
| 1. Egg. | 5 and 6. Body of males.
(Showing sound organs at A) |
| 2. Newly hatched larva. | 7. Body of female.
(Showing ovipositor) |
| 3. Full grown larva.
(Fourth stage) | 8. Adult female. |
| 4. Pupa (second stage).
(Very similar to first stage) | 9. Egg nests in twig. |

(Figs. 1, 2 and 3 greatly enlarged, after Marlatt; figs. 4-9 slightly reduced.)

The results of the cicada's egg-laying habits vary with different trees. The oaks show the effects most conspicuously; the leaves beyond the first punctures turn brown, and many of the twigs become so weak that they are broken off by the wind. Under the less hardy oaks the ground is sometimes almost covered with dead terminal twigs. A few weeks after a large brood has emerged, tracts of oak woodland appear as though they had been scorched by a forest fire. But some trees withstand the effects of the punctures fairly well, though the egg nests are prone to leave scars that eventually produce a weak spot in the growing branch.

The Seventeen-year Cicada fortunately appears mainly and most abundantly in woodland tracts, places where its injurious habits do not result in an appreciable, monetary loss. It likewise does not fly far from its breeding grounds. Nevertheless, it often does much harm to fruit trees. This is particularly the case wherever orchards and nurseries are located near wooded areas in which the cicadas may be numerous. Not only is nursery stock sometimes badly injured, but frequently young trees die from the results of the egg punctures.

A few days after a large brood of cicadas has emerged from the ground, the air resounds with the peculiar, whirring noise caused by the countless males. It is only the male that is capable of making the characteristic buzzing sound; and no other insects, except those belonging to the cicada family, have a similar musical apparatus. The sound organs occupy nearly the entire basal segment of the abdomen. The most conspicuous of these organs are two, covering flaps or opercula, visible only from below, and two tense, ribbed drum-like membranes which are vibrated by two powerful muscles. By raising

and lowering the abdomen, thereby changing the position of the opercula, as well as in other ways, the nature of the song is changed at will. So distinctive is the sound produced by the various species of cicadas, that a student learns to recognize many of them by their song alone.

The family Cicadidæ, of which the Periodical Cicada is the most noteworthy member, belongs to the order Hemiptera, which comprises the true bugs or those insects having a jointed beak fitted for piercing and sucking. The family is well represented throughout the tropical and temperate regions of both hemispheres, over eight hundred species having been described. Of this number one hundred and thirteen are listed from America north of Mexico. All of the females lay their eggs in the tissues of plants or trees; all of the males have the complex, sound organs, and are considered to be the noisiest insects in the world; but, with the exception of the Periodical Cicada, so far as known, not one of them requires more than two years for its development from the egg to the adult stage. The Dog-day Harvest-fly or Lyreman is one of the common cicadas that is heard every summer. As it is two-brooded, the adults appear every year.

The cicadas are fairly large, four-winged insects, with a blunt head, three-jointed beak arising near the base of the lower surface of the head, prominent compound eyes, three simple eyes or ocelli, and an abdomen consisting of six segments. The front legs are much thickened and armed with a spine beneath. The wings are of a similar texture throughout, and when at rest extend roof-like over the body. In the tropics many of the species are brightly colored, but in the United States they are mostly greenish marked with red and black.

There is no conclusive evidence apparently that the immature Periodical Cicada does very much injury to plants or trees during the long period that it feeds upon the juices of small roots. It is, therefore, only in exceptional cases, or in very limited areas, that it might prove desirable to destroy the young. According to Dr. Marlatt, the most satisfactory method of killing the larvæ is the use of bisulphide of carbon injected into the soil where it is known they are quite numerous.

In the adult stage the females unquestionably are very harmful to various trees and shrubs, though the damage they do is probably not nearly so extensive as is generally supposed. On oak trees, at least, the results of their egg-laying habits are much in the nature of a pruning. But in orchards and nurseries the trees are sometimes injured so severely that some means of protecting or saving them and destroying the cicadas must be adopted.

On account of the myriad of individuals over a wide area and the short life of the adults, the usual methods of destroying noxious insects are not always practical. The use of repellents to prevent the females from ovipositing has likewise not met with much success. When the adults emerge near orchards or nurseries, young fruit trees should, if possible, be protected by netting, and the cicadas resting thereon should be collected and killed every morning and evening, when they are somewhat sluggish. As the egg nests or scars often serve as openings for other destructive insects, it is quite essential to take proper care of young injured trees. In limited areas, like parks and yards containing shade trees and shrubbery, the emerging and adult cicadas can be readily killed by spraying them with a strong kerosene emulsion. Even the pupæ are not immune to an emulsion of kerosene, soap and

water. Since the various broods are known to appear during a definite year in different places, it is obviously unwise to plant nursery stock or orchards near woodland when this insect is soon due.

Although the Periodical Cicada may not appear to be decreasing in number to the casual observer, there is sufficient evidence to indicate that it is not nearly so abundant in many places as it was years ago. Mites and other insects prey upon it in its various stages, and very many of the rather helpless adults are devoured by birds, especially the English sparrow. But the most potent factors that are reducing their number are the diminishing woodland areas and the clearing of land for cultivation. It is, therefore, not improbable that in the distant future this long-lived insect may be exterminated by the agricultural development of the country.

WM. J. GERHARD,
Associate Curator of Insects.

SOME IMPORTANT PAPERS ON THE PERIODICAL CICADA

HOPKINS, A. D.—The Periodical Cicada or Seventeen-year Locust in West Virginia. (W. Va. Agric. Exper. Station, Bull. No. 68, 1900, pp. 259-330.)

MARLIATT, C. L.—The Periodical Cicada. (U. S. Dept. Agric., Bur. Ent., Bull. No. 71, 1907, pp. 1-181, 2nd edition.)

A very thorough paper on this insect, one containing a careful review of all of the contributions on the subject up to 1907, and with a bibliography of two hundred and eighty-six titles, the first of which appeared in 1666.

RILEY, C. V.—The Periodical Cicada. (First Rept. Insects Mo., 1869, pp. 18-42.)

SNODGRASS, R. C.—The Seventeen Year Locust. (Annual Rept. Smith. Inst., 1919, pp. 381-419.)

WALSH, BENJ., AND RILEY, C. V.—The Periodical Cicada. (Amer. Ent., I, 1868, pp. 63-72.)

The Periodical Cicada and its various stages are shown in the west end of Hall 19 on the Main Floor of Field Museum. Exhibits of this interesting insect are also loaned to the public schools of Chicago by the N. W. Harris Public School Extension of Field Museum of Natural History.

THE ALLIGATOR GAR

BY

ALFRED C. WEED

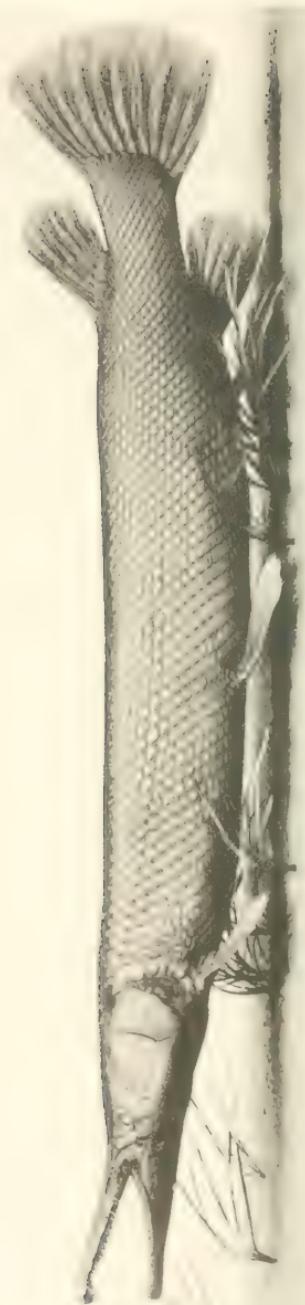
Assistant Curator of Fishes



FIELD MUSEUM OF NATURAL HISTORY

CHICAGO

1923



THE ALLIGATOR GAR.
FROM GROUP IN FIELD MUSEUM OF NATURAL HISTORY.

FIELD MUSEUM OF NATURAL HISTORY

DEPARTMENT OF ZOOLOGY

CHICAGO, 1923

LEAFLET

NUMBER 5

The Alligator Gar

Along the shore of the Gulf of Mexico and extending several hundred miles up the Mississippi River is a narrow strip of country which it is hardly correct to describe as either land or water. Most of the year it is out of the water or partly flooded but a rise of only a few feet in the rivers or an extra high tide may submerge large areas of it. Farther inland it rises slowly but even at St. Louis, a day's travel (700 miles) away from the Gulf, it is only, comparatively, a few feet above tidewater.

The streams of this region are mostly narrow and usually deep. The banks are composed of light mud or sand or of lighter material derived from the decay of the leaves or plants that grow in or fall in them. In a few hours the current may cut through a bend and leave a large part of the stream as a "horseshoe pond" or it may even cut through so as to reverse the direction of the current.

Many strange creatures, such as the Water Turkey, the Alligator Snapping Turtle, the Moccasin Snake and big catfish live in the swamps, lakes and bayous. This region is also the home of two strictly American creatures, the Alligator and the Alligator Gar or Great Gar. The Alligator has a small cousin in rivers of China but the gars are strictly American. The Alligator Gar is a great fish which probably owes its name to the fact that it is provided with a shining armor as hard and strong as the bony plates of the Alligator.

Most of the streams, ponds and bayous of this region are dark in color, either because the waters carry a load of mud or because they are stained a deep brown with the leachings from the soil. There are a few clear streams flowing over bottoms of sand or gravel, and it was in one of these that a friend had his first experience with an Alligator Gar. Walking along the bank, he stopped and looked down into the clear water of a large pool. Little by little he was able to pick out objects on the bottom and soon he realized that the things which looked so much like logs and posts were great fish. It did not take him long to return to the house and get a spear.

The fish were still in sight as he returned and he lost no time in striking at the nearest one. He seemed to miss the fish and strike a rock or something else that damaged the spear. After a few more trials he found that the injury came from striking the fish and that he could hardly startle them. The one he might strike would move a little but the others paid no attention to him. Later he tried to shoot one of the fish but even that did not seem to injure it very much.

Even those who do not like gars may find them extremely interesting. Their appearance is so different from that of most other fishes living today that it attracts attention. The geologist and the zoologist find that they resemble the fishes that lived in past ages much more than they do any that are known now. Their family tree goes far back before it unites them with the ancestors of other fishes.

There are about four species of gars, three of them being found in the United States. The southern limit of distribution is not well known. The Tropical Gar (*Lepisosteus tropicus*), if it is different from the Alligator Gar, seems to be confined to waters near the coast in Central America. The Alligator Gar, or Great

Gar (*Lepisosteus tristoechus*), is found in Cuba and along the coast of the Gulf of Mexico. It is common in the Mississippi River about to St. Louis and is often seen as far as the mouth of the Illinois River. Some are taken in the latter stream, almost every year, about as far up as Beardstown, Illinois. The Short-Nosed Gar (*Lepisosteus platostomus*) is found mostly in the Mississippi Valley region and in Lake Erie. The Long-Nosed Gar, or Billfish, (*Lepisosteus osseus*) is found in all suitable waters from the Gulf of Mexico to the Great Lakes, including the Atlantic Coastal Plain. They are fairly common market fish in parts of North Carolina.

There are several groups of living fishes which wear coats of mail. The Sea-Horses and the Pipefishes have a body covering of bony rings which lock together. The Trunkfishes have encased themselves in solid boxes of bone, much as the turtles have done. Many of the common fishes of the open ocean have strong series of bony plates along the sides of the tail. The sturgeons have rows of bony shields along the back and sides. Many of the catfishes of South America have similar protection. In two groups, the Bichirs and the Gars, the armor consists of a series of interlocking plates, smooth and shining, and hard as flint. The Bichirs are found in central and northern Africa and are related to the gars only inasmuch as both are the last representatives of the common fishes of ages long past.

The smooth, shining "ganoid" plates of the gars are composed of a hard outer layer much like the enamel of a tooth in structure and having a similar origin in the outer layer of the skin. Within is a softer structure much like the dentine of a tooth. These plates are so hard that it is, at least, a common story to tell of seeing fire fly from the edge of the axe

when trying to chop through the skin of a gar. Each plate has a long point which lies under the edge of the next one and is bound to it by the tough skin (Figs. 1 and 2). This gives great strength without stiffness.

One who may see a dead gar on the bank or watch a living one floating quietly at the surface is likely to get the idea that it is rather stiff and awkward in its movements. When at rest the gar—any gar—lies

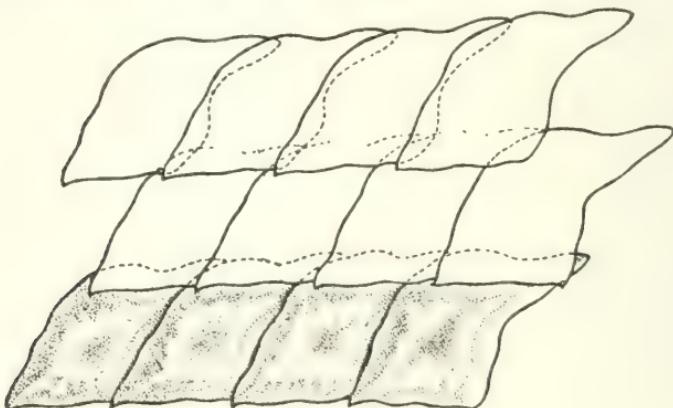


Fig. 1.

Bony plates of Alligator Gar, showing how they fit together.
Natural size.

quite straight, with none of the body movements of fish of less ancient lineage. The only sign of life is the movement of the balancing fins, to prevent being overturned by little currents in the water. All this is changed when the fish moves. The swimming gar is almost as sinuous as an eel. It may end its dash with a long, straight, pikelike shoot; but it uses its whole body in the exertion of starting.

The Short-Nosed Gar and the Tropical Gar do not reach a length much more than three feet. The Long-Billed Gar reaches a length of about six feet. The Alligator Gar is much larger. Even at a length of six feet it is much larger than a six-foot "Billfish."

The Great Gar is one of the largest fish in the fresh waters of North America. It may not be quite as large as some of the sturgeons that come into the bays along the Atlantic coast, but they are sea fish and seldom run up above tidewater. So little is known of this great fish that it is hard to get a true idea of its size. Estimates in the books run as high as twenty feet. Talks with fishermen along the river seem to

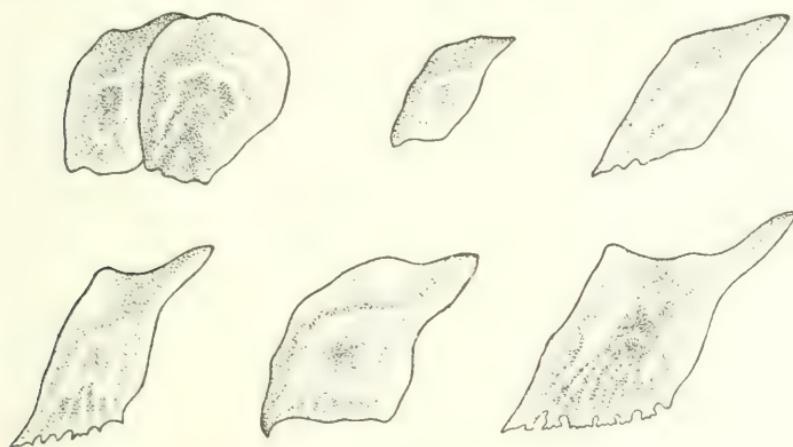


Fig. 2.

Bony plates of Alligator Gar, showing differences in size and form in different parts of the body.
Natural size.

show that a gar ten feet long is far beyond the average size. Below are given some of the records:

Dr. D. S. Jordan says the fish reaches a length of twenty feet but gives no record of specimens actually measured.

Mr. George Powers Dunbar, writing about 1840, said that gars of twelve to fourteen feet in length were "often seen in the Mississippi."

Mr. Percy Viosca, Jr., speaks of a record of a ten-foot specimen as "eye measurement."

Dr. L. Hussakof tells of seeing gars over nine feet long being cut up for food at Moon Lake, Mississippi.

Dr. S. E. Meek gives the length as ten to twelve feet but gives no record of actual measurement of specimens.

Jordan and Evermann give the length as eight to ten feet.

The New Orleans Times-Picayune tells of a specimen 8 feet long in the Louisiana State Museum.

A specimen eight feet, seven inches long was killed at Naples, Ill., early in the summer of 1922.

A specimen killed at Grafton, Illinois, early in 1922 weighed 87 pounds and was almost exactly six feet long.

Another, killed at Grafton some years ago was about seven and a half feet long and weighed 176 pounds.

One, six feet, six and a half inches to base of tail, was killed at Grafton by Mr. Sherman Reubel.

A specimen, seven feet, two inches long, is in the Illinois State Museum at Springfield, Ill.

One, five and a half feet long, is in the museum of Illinois University.

Two specimens, mounted, and one skeleton, each about seven feet long are in Field Museum.

An old record in Forest and Stream gives length seven feet, four inches, girth forty inches and weight 274½ pounds.

Dr. L. Hussakof tells of one six and a half feet long that swallowed a Short-Nosed Gar exactly one-third its length.

The habits of fishes are very largely determined by the conditions under which they live. Many of the species of the open ocean, especially relatives of the Mackerel, are strong, swift swimmers which may travel long distances at the same high speed without stopping to rest. There are no fishes of this type in our fresh water streams and lakes. The nearest ap-

proach to it is perhaps found in the Lake Trout and some other species in the larger lakes. They hunt their prey in the open water and catch it because they have greater speed.

The Black Bass, Brook Trout, and similar fishes lie in wait until their food floats or swims within striking distance. They are able to move with tremendous speed for a few feet but are seldom called upon to make any sustained effort. Their habit of living in very rapid water has led many to believe that they are fighting the current all the time. In reality they spend most of their lives in sheltered spots where their only effort must be to keep their balance as they are touched by little currents in different directions.

The Pike, Pickerel, Muskalonge and gars have still a different habit. They lie quietly at or near the surface of quiet bays or lakes, usually in places where there is a growth of weeds to hide them. There is no swift current to fight at any time. They may lie almost perfectly motionless for hours, always poised for a quick dash at any moving object. At an alarm, they may dash away a few feet but in their ordinary life they very seldom swim more than a hundred feet without stopping to rest and look around.

The food of any fish bears such a close relation to its habits that we can not discuss one without the other. If we know one we can usually make a guess as to the other.

Most of the observations on the food and habits of the gars have been made on the species common in the northeastern United States (the Long-Billed Gar). Because all the species have much the same general appearance, it has been assumed that they are alike in habits. This is a rather dangerous assumption. We are not even sure that the same fish has the same habits in different places.

Because one species of gar is very destructive to fishes in the Great Lakes region, it has been supposed that all gars eat only living food, which has proved its life by moving where the fish could see it. Thus, we find in the books such statements as: "It is very destructive to all sorts of food fishes." Occasionally we may find a note in some obscure place which shows other food habits. Thus, Jordan*, in giving a list of fishes of the lowland streams, says: "In Perdido Bay fresh water Alligator Gars and marine sharks compete for the garbage thrown over from the Pensacola wharves." The more common idea of this great fish, however, has been similar to that of George Powers Dunbar**:

"Possessed of an exceedingly ravenous appetite, he snaps at and devours everything which comes in his reach, and yet there are times when the most dainty morsel will scarcely tempt him. Early in the morning the water is continually broken by him as he rises to seize the floating insects, or small fish swimming upon the surface; but, as the sun ascends, if on the feed, he takes to the deeper water, slowly moving along in search of his prey, and occasionally rising and rolling on the surface in sport. Tired of the chase, he may be seen basking his huge and motionless form in some sunny nook, the shoals of mullet frisking and frolicking around him unheeded. Rapid, current or pool, the clear running spring stream, the sluggish bayou, the pond, or the salt creek, all are familiar to him, but he particularly affects the deep still bayou, or the entrance of some sluggish stream into a bright, clear and dashing current. Stand on the little bar formed by the junction of the last mentioned, and you may see him pass and repass, plunging into the current after a small fish, diving under the rooty bank, and rolling in fun on the top of the dark bayou, and snapping his jaws together, as if the livelong day were only created for him to rollick in. The ringing steel launched from the sturdy arm of the fisherman glances harmlessly from his more than steel-clad body, the river robber rolls his huge form through the deep river, now rising like a porpoise, and now with noiseless movement of a cat swimming slowly to the shallows, stealing along through the bright green leaves of the beautiful nelumbium to surprise the sunny perch or sleeping pike, or suddenly attracted by a passing shoal of sardine or mullet, he dashes like light to their center, his capacious and horrid jaws wide open and his sinewy tail dealing death on every

*Guide to the Study of Fishes, I, page 313.

**American Naturalist, Vol. XVI, page 384, May, 1882.

side. The wary bass retires to his shady nook, and the little patasa dive deeper into their rooty recesses at his approach, and woe betide the unlucky wight who trails his well-filled string of bass at the stern of his pirogue; the river robber is sure to attempt a rescue, and well will it be for the angler, as seizure once made, if he have a single fish left, of his morning's sport."

The New Orleans Times-Picayune, Sunday, January 22, 1922, carried a long article on this fish. The writer tried to prove that the Alligator Gar is much more dangerous to human life, in the waters it inhabits, than is the "Man-Eater Shark." Many instances were given of persons being killed or injured by these fish. Mr. Percy Viosca, Jr., has discussed this point very fully and his conclusions are that the Alligator Gar is almost strictly a scavenger. He claims that it never seizes a bait which is moving and does not take a quiet bait unless it has a strong odor. His explanation of the cases where persons have been seized are that they had been feeding the gars fish offal and then held their hands or feet in the water.

According to Mr. Viosca, the gars are capable of some domestication and are frequently fed daily at a certain point. Under such conditions, a gar might easily make a mistake and seize a hand or foot where it expected to find food.

Mr. Viosca says that game fish will bite freely within a few feet of the point where gars are feeding on garbage and that it is not uncommon for small boys to be swimming there also. He even tells that one of his friends once unhooked a six-foot gar which had taken a bait, boy and gar both in the water, and then took a ride as the fish dashed away.

Mr. Viosca's account of the habits of the gar does not match exactly with that of Mr. Dunbar. The key to the difficulty may be found in the statements of a friend who lived many years on the banks of the Illinois River. He says that the Short-Nosed Gar commonly fed on the offal from the fish houses and that it

was a very common thing to see them waiting for fish waste to be thrown overboard. His fish of the same species, from the same locality, when kept in an aquarium will eat nothing but living minnows and he has never been able to get them to take any dead food of any kind.

It is probable that the accounts of Mr. Dunbar and of Mr. Viosca are both correct. Where garbage is plentiful the fish eat garbage. In other places they eat whatever they can catch. If the gars are in the habit of eating garbage at a certain point, it would hardly seem wise to smear one's hands with fish refuse and hold them in the water just there.

Man is so constituted that he considers the value of other living things solely on a basis of his own comfort or convenience. A fish is useful or valuable to him only as he can see some direct relation to his needs or pleasures. On this basis, much has been said against the gars and very little in their favor. The fish culturist says that they eat the food needed for his young fish, and, later, that they eat the young fish. The commercial fisherman says that they tear his nets and are not salable if he does land them. The angler says they are not game and that they eat the fish he wants to catch. These statements are correct, so far as they go. To find the value of the gars we must look at other points.

Gars are occasionally used as food. Dr. Meek found them sold in the markets at Tampico, Mexico, and considered good food. Dr. Hussakof found them being salted and smoked for food at Moon Lake, Mississippi. Dr. Smith, in his report on the fishes of North Carolina tells of their being sold in the market at New Bern. There are some other reports of the sale of these fishes, usually smoked, for food. Dr. Smith also tells, on the authority of Dr. Capehart, that,

before the use of steel plows, the mould-boards of wooden plows were sometimes covered with gar skin. Gars are sometimes used for fertilizer and there is sometimes a local demand for their oil.

Gars are not usually considered game fish. They do not often take artificial baits readily and very few sportsmen try to catch them. Mr. Dunbar told of his experience in fishing for Alligator Gars but did not tell what kind of bait he used. Mr. Viosca tells that if a strong-scented cut bait is used it is easy to get the big fish on a hook but intimates that it is not possible to land them on anything less than shark tackle. At this distance, it looks as though a large Alligator Gar should give a very interesting fight to anyone who might fish for it with cut bait on Tarpon tackle. While the Alligator Gar is not likely to do so much jumping as a Tarpon, large specimens should give a very interesting struggle.

The total value of gars as food, as game or as scavengers may not be very great but it is, at least, worth mentioning. Their value to the pearl button industry is probably as great, but the connection is so obscure that it has not been suspected until very recently. The relation between a pearl-handled knife and an Alligator Gar may not seem very close and yet the best shells for making knife handles and other novelties could not live without the gars.

To understand this point we must review the prominent points in the life history of the fresh water clam. The eggs of this creature, after being fertilized, pass into the gills of the mother and remain there until they have hatched. The young are called "glochidia" and do not look much like the river clams we know. The shells are of different shapes and often have long, sharp teeth on the edge.

At the proper season the glochidia leave the brood

pouch in their mother's gills and pass out into the water. There they drift around at the mercy of the currents until they die or find a proper place to anchor themselves. Some of them can anchor to the fins of almost any kind of fish. Others can fasten to the gills of almost any fish. Most of the more valuable species must reach the right place on some particular fish. This is the case with the Yellow Sand Shell (*Lampsilis anodontoides*) which Mr. R. L. Barney, Director of the U. S. Bureau of Fisheries Biological Station at Fairport, Iowa, says: "is without a doubt the most valuable shell of the Mississippi drainage because of its use in the manufacture of pearl handles for knives, razors, etc., and because of its serviceability in button manufacture." This shell must attach itself to the gills of a gar to pass through this next period of its life.

After it has become properly attached, the flesh of the fish grows up around the glochidium and it stays there as a true parasite for a time varying from several days to several weeks, when its transformation is complete. At the proper time the flesh around the young clam loosens and it falls to the bottom of the stream or pond, ready to feed and live like any other of its species.

The Yellow Sand Shell grows to large size. It is long and fairly straight. It is of soft, even texture and does not split readily into separate layers. It is free from color. Apparently it grows very rapidly under favorable conditions. Altogether it seems to be one of the most promising shells for artificial propagation. If it is to be raised for the use of the button factories it will be necessary to keep somegars in the breeding ponds. However, the stock of gars for this purpose does not seem to be in danger of being entirely destroyed immediately.

We may sum up the case of the Alligator Gar about as follows: Its enemies allege that it is very destructive to the game fish that live in the streams and ponds with it. They say that it is of no value as food for man. Some of them claim that it is very dangerous to human life. They say it destroys the nets of the commercial fishermen. Whether it destroys many adult fish or not, it eats a great deal of food that the young fish need.

On the other hand, we may say that it has some value as food. It has some value as a game fish and this value may increase. It is a scavenger, at least in certain localities. In its capacity as a scavenger it may injure human beings by mistake and this may be the explanation of the actual cases of injury or death. It is one of the three species that seem to be necessary for the breeding of the best button shell.

Not much is known about the breeding of the Alligator Gar or about its growth after hatching but it is not likely that it is especially different from that of the other gars. A very good account of the habits of this fish was written almost a hundred years ago by Mr. George Powers Dunbar, a forgotten scientist, who made some observations about the lower Mississippi.

Mr. Dunbar says:

"During the months of December and January the fish seek the heads of the still and almost stagnant bayous or the deep caves of the sluggish rivers to deposit their spawn. The eggs are held suspended in a thick gelatinous transparent substance, forming long ropes several inches in diameter, which are hung on old snags, roots or branches of trees that have fallen into the water. The spawn has much the appearance of that of the frog, with the exception of the circular form it assumes, and the size of the eggs, which are about as large as No. 4 shot, and of a dark purple color. The young come forth during the spring, and tiny little rascals they are, but they grow with astonishing rapidity, and by the latter part of August are some fourteen inches in length and weigh several ounces; in one year they reach a weight of from nine to twelve pounds, and go on increasing to several hundreds. Large numbers of these fry are destroyed by

other fish, and well that it is so, otherwise no fish could live in any of the rivers for them, the ovaries of a large fish containing several hundred thousand eggs."

When young gars are first hatched they are very different in appearance from the adults. They have no bony plates and no long snout. The end of the snout projects beyond the rather small mouth and bears a patch of suckers which the little fish uses to attach itself to anything that seems to offer a safe hold. As the fish grows and the jaws are longer this patch of suckers is less needed and finally almost disappears. All that is left of it is the knob at the end of the upper jaw.

In the young gar the fins are indicated only by small folds of skin and the slender tail ends in a point. After a few days a small fin begins to show on the lower side of the tail. As this grows, the tail filament turns up more and more and either gets smaller or does not grow much until finally it is entirely hidden under the skin and scales while the fin, that started below, seems to be directly at the end of the body. By the time the young gar has reached a length of five or six inches it is practically like the adults in form but may be different in color.

The group in Hall 18 represents two of these large fish as they might be seen lying near the bottom in a quiet pool in a clear stream. In such places, where there is little current and where the sunlight can reach them, many of these fish may be seen, each facing the current and maintaining its position by very slight movements of tail or fins. Here they rest, perhaps for hours, until they start off on the search for food or play.

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THE WILD TURKEY

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THE WILD TURKEY.
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LEAFLET

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The Wild Turkey

One of the first forms of wild life to attract attention, in the early days of exploration and settlement in America, was the Wild Turkey. This splendid bird once ranged in abundance from the Atlantic coast to the Dakotas, and from Maine and southern Ontario to southern Mexico. It was found in every state in the Union except Washington, Oregon, California, Nevada, Utah, Idaho, Wyoming and Montana. Early in the history of the colonization, however, the turkey began its retreat and gradually retired to the wilderness in the more southern and western portions of its range, a retreat which has gone on steadily since then, with varying rapidity.

The early explorers and colonists were unanimous in speaking of the tremendous numbers of this magnificent species. When Francisco Fernandez reached the northern coast of Yucatan in 1517, he found great numbers of turkeys domesticated by the natives, as did Grijalva farther west in 1518, and Cortez a little later. The colonists in New England found a bountiful supply of these birds in the forests, and the use to which they put them is well exemplified by the prominent part the turkey plays in our Thanksgiving festivals today, a role which has come down to us from the first Thanksgiving of those early times. The French "voyageurs," in penetrating the western wilds, discovered the Wild Turkey in great numbers and recorded their gratefulness for the welcome food supply thus furnished. The accounts of Capt. John Smith,

Roger Williams, Father Marquette and La Salle, among many others, show clearly that the Wild Turkey must have existed in countless numbers.

As early as 1760, a change began to appear in these accounts, especially in those relating to the north-eastern portions of the country. In this year there was written an article relating to southern Canada in which the writer remarks that turkeys were to be found "except in the neighborhood of plantations." In 1765, a writer in Maryland stated that Wild Turkeys, formerly abundant, were then rarely seen. In 1770 the species was reported as very scarce in Pennsylvania. By 1792, in Connecticut, the turkey had retired to the inland mountainous region, while in 1813 there was given what appears to be the last record of its occurrence for the entire state. In 1842 an author reports the species as "exceedingly rare in all parts of New England."

In the western states, the turkey held its own for a longer time, owing to the slower development of that region, and in 1846 great numbers were still reported from the bottom lands of the upper Mississippi. In 1892, however, it had almost totally disappeared from Minnesota. In 1893 it was given as rare, if at all present, in Michigan. In 1897 the same was true of Indiana. In 1903 it was all but extinct in Ohio; in 1907, practically extinct in Iowa; in 1915, extinct in Nebraska; in 1920 extinct in South Dakota. The exact date of disappearance in these states is uncertain. In Illinois it was thought by Ridgway to be extinct in 1913, but more recently it has been found to occur sparingly in extreme southern portions of the state. In Pennsylvania there is no doubt that the species still occurs in some numbers, locally, for as late as 1913 the game warden of that state reported 733 Wild Turkeys as having been killed by sportsmen during one

season. Farther south and west there are numerous localities in which the birds are still common, and records are given more or less regularly from southern Missouri, Mississippi, Arkansas, Oklahoma, Colorado, Texas, North and South Carolina, Louisiana, Florida and some other adjoining states. Even in these, however, the distribution is purely local, and the turkeys are confined to suitable localities in restricted areas.

It is unknown whence came the actual specimen from which the first recognized description of the species was written. It has been assumed that the bird was a domesticated one, descended from the Mexican race. It is certain that the domestic bird, today, shows much more resemblance to the form found in eastern Mexico than to those of other regions. The turkeys found by the Spaniards in Mexico, already domesticated by the Aztecs, were taken back to Spain, and by 1530 were well established in the poultry yards of that country. From Spain they were carried all over Europe and even, in time, found their way to the colonies in New England where they may have been crossed with the resident form of the forests, also occasionally domesticated. Some of the resultant mixed breed of New England may have been carried to Europe, but it is doubtful if one of these birds was the basis for the original scientific descriptions which apply too well to the east-Mexican race.

The source of the name "turkey" is likewise in doubt. Certain early writers say that the bird received its name from Turkey, from whence it was supposed to have come, but there is little evidence to show that there was ever much doubt as to the country of the turkey's origin. For some time, the species was confused with the Guinea-fowl which was, likewise, called "turkey," and both birds were classed as pheasant, peacock and even Guinea-fowl, until the various forms involved

were gradually classified properly. Another explanation of the origin of the name is sought in certain of the bird's notes which resemble the syllables, "turk-turk-turk—," from which the name "turkey" came to be applied to the bird itself, and this explanation is probably the true one.

The Aztecs called the gobblers "Huexolotl" and the hens "Cihuatotolin." The northern tribes named them variously, as "Neyhom" (Natick), "Tschikenum" or "Tschukinuuna" (Delawares), "Weneecobbo" (Chippewa), "Ma-yoka" (Biloxi), "Pah-quun" (Nanticoke), "Bloen" (Lenape), "Zizika" (Omahas) and "Fakit" (Choctaw). These northern tribes did not commonly domesticate the turkey as did the Aztecs, but made use of the wild birds which they hunted regularly. The plumage was manufactured into robes and blankets by a process of twisting each feather separately into strands of wild hemp which were then woven into a compact fabric.

The Wild Turkey is a handsome bird, its glossy plumage mostly greenish bronze with gold and coppery reflections, catching every turn of sunlight and shining like polished metal. Each feather of the neck, breast, flanks and upper back is squarely shorn and tipped with a band of velvety black which serves but to accentuate the glowing sheen of the remainder. The wings are blackish brown, crossed with bands of white. The head and upper neck are nearly bare, the skin rich purple or blue in color, sparsely set with rows of hair-like feathers. From the throat depends a wattle-like fold, and from the crown hangs a pencil-like projection of the skin, set with bristles and tipped with a slender tuft of the same. From the center of the breast springs a bunch of wiry feathers which trails downward, and in some superb examples, reaches the ground between the owner's feet.

The feet are light purple, armed with short but heavy spurs. In general appearance the bird thus resembles a fine example of the domestic turkey although there are certain differences which distinguish the two forms. Throughout most of the United States, except in the extreme southwest, the most striking difference is in the color of the rump, upper tail coverts and tail which are rich chestnut in the wild bird but white in the domesticated one. This characteristic shows the relationship of the barnyard fowl to the wild bird of eastern Mexico which presents the same color phase. Other differences, however, are noticeable without respect to locality. The domestic bird is somewhat smaller than the wild one, the naked skin of the head and feet often has faded into red and even orange, and the wattle of the "gobbler" has developed into an enormous dewlap which is never so pronounced in the wild form. These characters are of principal importance in the case of the domestic strain known as the Bronze Turkey which has descended with least change from its wild ancestor and which is most likely to be confused with it. There are, in addition, other strains of the domestic bird which are so widely different from any of the wild individuals that there is little doubt as to their character, even at a glance. As in the case of the Bronze Turkey, the names of these varieties are based, for the most part, on their distinguishing colors, and a Black, White, Buff or Blue-gray Turkey need not be described further, while the Narragansett breed could be characterized as the Steel-gray Turkey.

On the other hand there is a gradual but decided change in coloration exhibited by the Wild Turkey from one end of its range to the other, from the Mexican to the New England forms. On account of this

variation, naturalists have divided the species into several subspecies or geographical races, each of which is distinct from the others and occupies a separate area of distribution, although the races intergrade where the areas meet. At present, six of these races are recognized and named. The typical race or true Wild Turkey (*Meleagris gallopavo gallopavo*), is characterized by having the feathers of the lower back, rump, upper tail coverts and tail tipped with nearly pure white. It is confined to the humid valleys and lower hillsides of eastern Mexico, and does not reach the United States. To the northward, in the states of Coahuila, Nuevo Leon and Tamaulipas, this form intergrades with the Rio Grande Turkey (*Meleagris g. intermedia*) which crosses the Mexican boundary and ranges into middle northern Texas. In this form, the white of the posterior upper parts and tail is replaced by ochraceous buff. In northern Texas and extending over almost all of the whole eastern range of the species is found the North American Wild Turkey (*Meleagris g. silvestris*) in which the buff of the Rio Grande Turkey is deepened into rich chestnut. In southern Florida is found a very similar race, the Florida Turkey (*Meleagris g. osceola*), which differs from the northern race by having the white cross bars on the wing quills narrower. In the mountains of western Mexico, on the high plateau region, occurs the Mexican Wild Turkey (*Meleagris g. mexicana*), in which the tail, upper tail-coverts and lower rump are white, as in the east Mexican bird, while the lower back is rich black without pale tips to the feathers. This form does not cross into the United States, but is replaced in western Texas, New Mexico, Arizona and southern Colorado by Merriam's Turkey (*Meleagris g. merriami*), in which the lower back is also black with the succeeding upper parts broadly tipped with pale buff

or buffy white. Six races or subspecies are thus distinguished throughout the range of the species, four of which occur in the United States.

The differences by which the subspecies of the Wild Turkey are separated are, as may be noted, modifications of certain colors and markings. Although constant in each locality, they show an intergradation where the ranges of the various forms adjoin, and the birds found in the area of intergradation possess an intermediate character which often renders them difficult to classify. In a general way, it may be said that these differences have arisen naturally through a gradual modification of the birds in each of various areas, from causes operating over a long period of time. The exact causes in each case may never be known, but the slight "continuous" variations are hereditary and are passed on from generation to generation. This is at least one of the ways in which new species are produced in nature by gradual evolution. On the other hand, the various strains of the domestic turkey have been produced through the agency of man, from a second type of variation known as "discontinuous" or as "mutation." Such variations, which are often strikingly distinct, are seldom seen in nature because they are quickly lost through interbreeding. In domesticated animals and plants, however, man is able to detect these "mutants" or "sports" as they appear and, by mating selected individuals, can perpetuate the desired features. In this manner he has produced the peculiar varieties of the domestic turkey, black, white, buff and others, none of which have counterparts in the races of the wild form.

The Wild Turkey is essentially a bird of the woodlands, seldom wandering far from the protection of groves and thickets and preferring a mixed growth

in swampy regions where a variety of food and facility for concealment are offered. It is irregularly migratory and formerly was much more so than it is at present, when its haunts are more or less encircled by large cultivated areas. In early times, when food became scarce in the northern parts of the Turkeys' range, especially in the autumn, the birds would wander long distances to the richer bottom lands of the Mississippi and other river valleys until they reached a region where food became more plentiful. This gypsy migration was performed by flocks, numbering sometimes a hundred individuals, of which the males always formed a separate body. The females and young remained apart in family groups or composite flocks, but all moved forward in the same direction. They traveled on foot except when rivers were encountered, when the birds took wing and crossed the expanse of water in flight, resuming the march upon the other side. At nightfall, they ascended to the trees and roosted until daybreak, beginning the journey again the following morning. When suitable feeding ground was secured, the flocks spent the winter roaming about and fattening on the nuts and berries which formed their winter food. At such times, they appeared to become somewhat fearless of man and often associated with the domestic fowls about the farm houses. In recent times, the flocking instincts of the species remain the same but the migratory habits are, of necessity, restricted.

About the middle of February or in early March, the mating instincts of the Wild Turkey are aroused and the selection of sexes is begun. The males are quite polygamous, although the females are constant to a single mate. At this season, the "gobblers" strut about, gobbling and puffing, ruffling their feathers and dragging their wings, performing in every way like

their barnyard counterparts to attract the attention of the females. Rival suitors frequently engage in bloody combats which, on rare occasions, may result in the death of one of the contestants. The hens, when they bestow their affections, join the following of the successful suitor and remain more or less in his company until the actual time of nesting begins.

The nesting of the Wild Turkey begins in the middle of March or April. The hen selects a site at the foot of a tree or log, or under the bushes, well concealed from casual observation, and there scoops out a shallow depression which is lined with dead leaves. The "gobbler" renders no assistance at this task. The site is chosen for its dryness as well as for its secrecy, and secrecy marks all the operations in connection with it. Islands are frequently chosen in this regard, for not only are they less open to investigation but, in addition, there is often present a considerable pile of driftwood at the upper end, into which the hen may make her stealthy way when discovery is imminent.

The eggs number from 8 to 15, sometimes 20, and measure about $2\frac{1}{3}$ by $1\frac{4}{5}$ inches. In color, they vary from pale creamy white to buff, dotted and spotted with pale chocolate or reddish brown, rarely with lilac. Sometimes several females occupy the same nest and sit together, possibly for mutual protection. Audubon records the discovery of such a communal nest which contained 42 eggs. As a rule, however, the hens nest separately. Incubation occupies about four weeks. During that time the hen sits closely, not moving when approached as long as she considers herself unobserved. Should casual notice quicken into interest, she is able to detect the change and escapes hurriedly to a little distance from which she watches the proceedings. When leaving the nest deliberately, she never fails to cover the eggs most carefully with dry leaves

to hide them from discovery. If the nest is disturbed during her absence, she does not usually desert it unless some of the eggs are broken or destroyed. In such case, she abandons the nest, calls for her mate, constructs another nest and again attempts to rear a brood. Otherwise, only one brood is reared each year, at least in the northern regions, and the hen does not associate with the "gobbler" until the following spring.

When the young are about to hatch, the female, according to Audubon, will not leave the nest under any circumstances. The young are active and leave the nest the same day they are hatched. That day or the next, they begin their wandering existence and never return. They are somewhat delicate at first, unusually susceptible to dampness under foot, and for this reason are carefully tended by the mother bird and led, as soon as may be, to higher, drier ground. When two weeks old, they are able to fly sufficiently to reach the lower branches of the trees, and from that time on they roost above ground. As they grow older they wander more widely and, little by little, assemble into the mixed family groups which associate for the winter. During this time, as soon as the females have withdrawn into seclusion to brood and rear their young, the gobblers retire for a period of rest and recuperation. In late summer they also begin to assemble in flocks. Sometimes they are joined, in late winter, by an occasional young male, but the association does not seem to continue for any great length of time and the younger bird goes off by itself or rejoins the family group.

The food of the Wild Turkey consists largely of wild fruits and berries, nuts, acorns, herbs and grass, many kinds of insects, and even frogs and small lizards. Grasshoppers are a favorite article of diet with the half-grown young, and corn and other grains with

the old birds. A thorough study of the stomachs of Wild Turkeys made by the Bureau of Biological Survey, U. S. Department of Agriculture, shows some interesting facts relative to the food of this species. The general conclusions reached by the study are that the Wild Turkey should be considered as beneficial rather than injurious, although the rarity of the birds is such that the actual effect of their activities is negligible. Owing to the fondness of turkeys for swampy bottomlands and for roosting over water, they sometimes find themselves cut off from solid ground through inundation. At such times they may be forced to remain in the tree-tops for days or even weeks, subsisting only on buds and leaves. This works no hardship with them at certain seasons, but at other times, they may become very emaciated before their enforced imprisonment is at an end.

The Wild Turkey is beset throughout its lifetime by a host of enemies. Wolves, foxes, raccoons, opossums, skunks and rats, among the mammals, prey upon the birds according to their size, and rob the nests whenever they find them deserted or can drive away the occupants. Among the birds, the crow destroys the eggs and, sometimes, the young birds, while certain hawks and eagles and the Great Horned Owl attack the half grown young and even the full grown individuals. The Great Horned Owl is said to rouse the sleeping turkeys by its call and, selecting a victim, crowd it off its perch until the bird takes wing, whereupon it follows in pursuit and captures it in flight.

In its relations with man, the Wild Turkey has suffered more than in contact with any other of its foes. From the earliest times in its history, it has been not only an article of food but an object of the chase, and many are the devices and meth-

ods used in its pursuit. It is probably due to some of these methods that the species has been obliged to leave many of its former haunts. At any rate, hunting by the white man rapidly effected a change in the habits of the bird. At one time not unduly suspicious or shy, it soon developed traits which made it one of the most difficult of game birds to approach by ordinary means. The early writers often speak of the Wild Turkey as being, at times, even stupid, but greater familiarity with the white man's ways taught the birds to be more cunning, and Audubon, as early as 1831, described them as extremely shy and suspicious of both white man and red.

Perhaps the principal agency in wholesale destruction was the trap. By its use, large numbers of Wild Turkeys could be secured without difficulty and without particular knowledge or skill on the part of the hunter. The traps were simple, penned enclosures, often built of logs, having as entrance a slightly lifted rail or a shallow trench beneath one side of the structure. Through the opening was laid a trail of corn. The turkeys, feeding head downward, squeezed through the opening and into the trap, but once inside, with heads upraised, they endeavored only to escape above and, except by accident, could not find their way through the opening which gave them entrance.

Shooting the roosting birds by moonlight was often practiced, and required some skill with the rifle, as the game invariably roosted high. Coursing with greyhounds offered sport to another class of hunters and gave a certain amount of excitement since the birds, while fresh, could outrun the dogs or horses. If followed persistently, however, they were soon obliged to stop, exhausted, or were driven to short and shorter flights until overcome. If pressed too closely at the start, their usual course was to take flight to a

distant grove without attempting to run. Coursing was practicable only when the birds had wandered from the woods to feed on the outlying prairie.

Stalking or still-hunting was yet another method of turkey hunting much in favor. It was necessary to use extreme caution in approach, not to set the birds to running. When approached quietly, the turkeys could be seen at some distance, with their heads above the undergrowth, and so picked off with a rifle. If stalked very closely before discovering the hunter, they crouched low and rose suddenly, offering a chance for a wing shot. Tracking in the snow sometimes afforded an easy method of following up the flocks.

One of the favorite methods of hunting the Wild Turkey has been that of "calling." By the use of a hollow wing bone of a turkey, a joint of cane, a leaf placed against the lips or a sharp-edged wooden box with a piece of slate for a scraper, the various notes of the "gobblers" or hens can be imitated with more or less accuracy, depending on the skill of the hunter. The latter, concealed in some suitable spot, calls up the birds and shoots them as they appear. It is necessary to be exact in the imitation, for the turkey is able to detect false notes and imperfections in the counterfeit voice, and either will not respond or may take alarm. Furthermore, a knowledge of "turkey talk" is also essential for the best results, so that the proper call can be used. Each variety of turkey notes has a different significance, and the calls of the hens and young males are distinguishable from those of the old "gobblers". Hence the hunter must vary his performance according to season and circumstance. A young male may not respond to a hen's call note, nor will a "gobbler" reply to a young male. The method of calling probably requires more patience, skill and turkey lore than any other of the hunting practices.

There seem to have been few, if any, attempts to re-introduce the Wild Turkey as a game bird into any of its former haunts. The disappearance of the species from these localities has been due largely to the diminution of suitable ranges for the birds and the unfavorable conditions still remain. Areas, formerly in virgin woodland, have been broken up and deforested, and the solitudes have been shattered by the automobile and the ubiquitous camper-tourist. With the passing of the wilderness, the Wild Turkey has quietly retired to those less inhabited regions where it can still enjoy undisturbed seclusion and wander at will.

Several efforts have been made to introduce the species outside of its former range. In California, for example, on various occasions dating back to 1877, Wild Turkeys have been taken from Mexico and Virginia and released on certain reservations, but most of the birds have disappeared from one cause or another. A few flocks are reported to be still in existence in the Sequoia National Park, where they are tame and fearless. These may prosper under protection, but not as game birds with an open season declared upon them. Likewise, in those areas where the Wild Turkey still exists in natural condition, it may not hold its own for all time so long as there are seasons for hunting it and hunters to pursue it. Although not yet extinct, it must be classed with our vanishing game birds,—in the opinion of those who know it best, the noblest of them all.

JOHN T. ZIMMER,
Assistant Curator of Birds.

BOOKS AND ARTICLES ABOUT THE WILD TURKEY

The literature dealing with the Wild Turkey is so voluminous that it is impossible to quote a complete bibliography. A brief list is here given of a few of the more detailed accounts.

AUDUBON, JOHN JAMES—*The Birds of America*, Vol. I, pp. 1-17 (Edinburgh, 1831), and other editions.

A long and interesting account of the habits of the Wild Turkey at a time when it was considerably more abundant than at present.

BENDIRE, CHARLES E.—*Life Histories of North American Birds* (U. S. National Museum, Special Bulletin No. 1, pp. 112-119, 1892).

Accounts of various observers on the nesting and other habits of the U. S. and Mexican Turkeys.

JUDD SYLVESTER D.—*The Grouse and Wild Turkeys of the U. S. and Their Economic Value*, pp. 48-52 (U. S. Dept. Agriculture, Bureau of Biol. Survey, Bull. 24, 1905).

A study of the food habits of the Wild Turkeys and their allies, based on examination of stomachs.

KING, MAJOR W. ROSS—*The Sportsman and Naturalist in Canada*, pp. 125-139 (London 1866).

Gives some good descriptions of turkey habits and hunting in Canada.

MCILHENNY, EDWARD A.—*The Wild Turkey and Its Hunting* (New York, 1914).

An interesting book dealing entirely with the Wild Turkey and its ways.

WRIGHT, ALBERT HAZEN—*Early Records for the Wild Turkey* (Auk, Vol. 31, pp. 334-358 and 463-473; Vol. 32, pp. 61-81, 207-224, and 348-366, 1914-1915).

A synopsis of references to the Wild Turkey in literature, from the earliest times to about 1870.

The Wild Turkey is shown in a handsome group in Hall 20 of the Field Museum. The group represents a winter scene in Madison Parish, western Louisiana, with a flock of fine "gobblers" in the open woods, strutting, feeding and resting.

THE MAN-EATING LIONS OF TSAVO

BY

LIEUT.-COL. J. H. PATTERSON, D. S. O.



ZOOLOGY
LEAFLET 7

FIELD MUSEUM OF NATURAL HISTORY
CHICAGO
1925

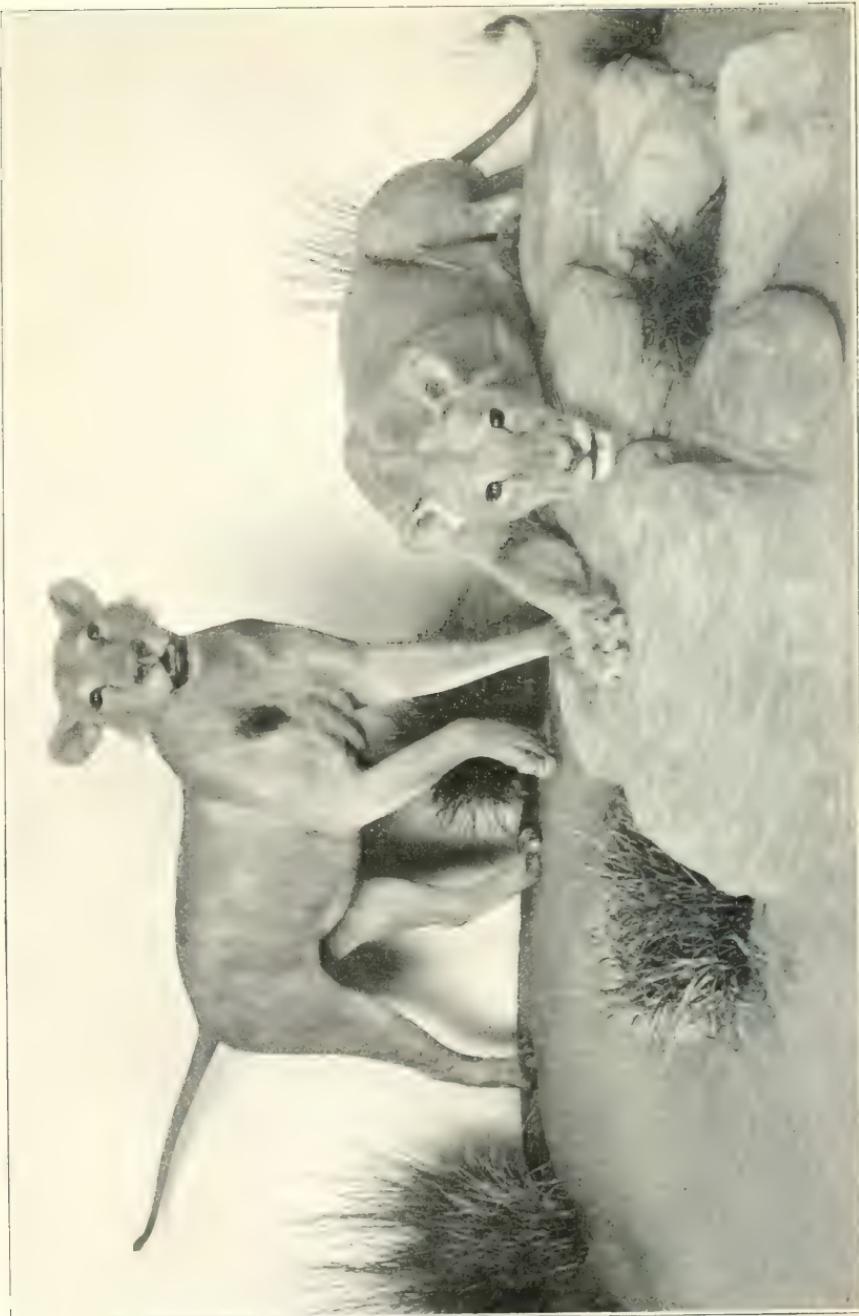
The Zoological Leaflets of Field Museum are devoted to brief, non-technical accounts of the history, classification, distribution and life habits of animals, with especial reference to subjects shown in the Museum's exhibits.

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D. C. DAVIES, DIRECTOR

FIELD MUSEUM OF NATURAL HISTORY
CHICAGO, U.S.A.



THE MAN-EATERS AS SHOWN IN THE GROUP IN FIELD MUSEUM OF NATURAL HISTORY.

FIELD MUSEUM OF NATURAL HISTORY

DEPARTMENT OF ZOOLOGY

CHICAGO, 1925

LEAFLET

NUMBER 7

The Man-Eating Lions of Tsavo*

When the visitor to the Field Museum pauses before the life-like forms of the Tsavo man-eaters, it will be hard for him to realize that these two ferocious brutes killed and devoured, under the most appalling circumstances, one hundred and thirty-five Indian and African artisans and laborers employed in the construction of the Uganda Railway. For over nine months these insatiable monsters carried on an intermittent warfare against the Railway and all those connected with it in the neighborhood of Tsavo. This culminated in a regular "reign of terror" when they finally succeeded in bringing the railway works for a time to a complete standstill.

A late great President of the United States, that man with the wonderful personality—Theodore Roosevelt—has put it on record that "the story of the Man-Eaters of Tsavo is by far the most remarkable account of which we have any record;" while that veteran big

*This leaflet, prepared by Col. J. H. Patterson, recounts the main events of his remarkable experiences with man-eating lions previously told at greater length in his well-known book "The Man-Eaters of Tsavo." In 1924, Col. Patterson delivered a public lecture in the Field Museum. At that time he remarked to President Stanley Field, of the Museum, that he still possessed the skins of the famous killers of men. As a result, they were purchased by Mr. Field and presented to the Museum. With considerable difficulty, owing to the age of the skins, they were mounted and are now permanently preserved in the spirited group shown in the accompanying illustration.

game hunter and African pioneer, Selous, who was himself killed in Africa, not far from Tsavo, wrote as follows:—

“No lion story that I ever heard or read equals in its long sustained dramatic interest the story of the man-eaters of Tsavo. It is an epic of terrible tragedies spread out over several months and only at last brought to an end by the resource and determination of one man.”

These remarkable lions had the distinction, probably unique among wild animals, of being specifically referred to in the British Parliament by the Prime Minister of the day, the Marquis of Salisbury, who in apologizing for the delay in the construction of the Uganda Railway said:—

“The whole of the works were put to a stop because a pair of man-eating lions appeared in the locality and conceived a most unfortunate taste for our workmen. At last the labourers entirely declined to carry on unless they were guarded by iron entrenchments. Of course it is difficult to work a railway under these conditions and until we found an enthusiastic sportsman to get rid of these lions our enterprise was seriously hindered.”

WORK BEGINS AT TSAVO.

When I landed at Mombasa, I fully expected to encounter many trials and hardships while engaged in building the railway through an inhospitable and savage territory. I anticipated engineering difficulties, perils from sunstroke and fevers, a possible scarcity of food and water,—but never for a moment did I realize that the African wilderness held in its mysterious recesses two prowling demons who looked upon myself and my workmen as a sort of manna sent down from Heaven for their special delectation. All other difficulties were as nothing compared to the terrible toll

of human sacrifice exacted nightly by these savage monsters who made Tsavo their headquarters and gave to that district an evil repute which lasts to this day.

Mombasa, the starting point of the Uganda Railway, is an old Arab city fringed with palms and washed by the warm waters of the Indian Ocean. Up to the time of my arrival in tropical Africa, I had pictured to myself a desolate shore, sandy, rock-strewn, with a scorching sun burning up everything beneath it, but my first view of Mombasa gave me a pleasant surprise. Green verdure abounded far as the eye could reach, while dazzlingly white, flat-roofed houses peeped out between tall cocoanut and spreading mango trees, waving palms and huge baobabs, forming a most delightful and beautiful picture, framed against a dark background of well-wooded verdant hills. The old town was bathed in brilliant sunshine and was reflected dreamily in the motionless sea.

At the time of my arrival, railhead had just reached Tsavo, about one hundred and thirty miles from the coast. Here it was found that a river, fed from the everlasting snows of Mount Kilimanjaro, surged across the track. The river ran in the center of a wide and deep depression, worn away in the course of ages, and this rift had to be spanned by means of a bridge. I was deputied to build this bridge and to carry out all the engineering works in the district.

After spending a few days at Mombasa, I set out for my headquarters. For twenty miles or so after leaving the coast, the railway wound steadily upwards through beautifully wooded, park-like country, and, on looking back out of the carriage window, I could every now and then obtain lovely views of Mombasa, while beyond the Indian Ocean sparkled in the glorious sunshine as far as the eye could reach. Soon, however, the whole character of the country changed. Green, smiling, well-wooded uplands gave place to a wilder-

ness covered with bushy scrub and stunted trees, and carpeted with a layer of fine red dust which penetrated into every nook and cranny. Towards dusk we reached Tsavo and I felt somewhat depressed by the desolation and loneliness of my new surroundings. I slept that night in a little palm hut which had been built by some previous traveller, and which was fortunately unoccupied for the time being. It was rather broken-down and dilapidated, not even possessing a door, and as I lay on my narrow camp bed I could see the stars twinkling through the broken roof. I little knew then what adventures awaited me in this neighborhood; and, if I had realized that at that very time two savage brutes were prowling round, seeking whom they might devour, I hardly think I should have slept so peacefully.

The next morning I was up betimes, eager to make acquaintance with my new surroundings. My first impression on coming out of the hut was that I was hemmed in on all sides with a dense growth of impenetrable jungle; on scrambling to the top of a little hill close at hand, I found that the whole country as far as I could see was covered with low, stunted trees, thick undergrowth and "wait-a-bit" thorns. The only clearing, indeed, appeared to be where the narrow track for the railway had been cut. This interminable *nyika*, or wilderness of whitish and leafless dwarf trees, presented a ghastly and sun-stricken appearance; here and there a ridge of dark-red, heat-blistered rock jutted out above the jungle, and added its rugged barrenness to the dreariness of the picture. Away to the north-east stretched the unbroken line of the N'dungu Escarpment, while far off to the south I could just catch a glimpse of the snow-capped top of towering Kilimanjaro. The one redeeming feature of the neighborhood was the river from which Tsavo takes its name; this is a swiftly-flowing stream, always cool and

always running, the latter being an exceptional attribute in this part of East Africa. The fringe of lofty green trees along its banks formed a welcome relief to the general monotony of the landscape. When I had thus obtained a rough idea of the neighborhood, I returned to my hut, and began in earnest to make preparations for my stay in this outlandish place. The stores were unpacked, and my "boys" pitched my tent in a little clearing close to the shelter where I had slept the night before and not far from the main camp.

Railhead had at this time just reached the western side of the river, and some thousands of Indian coolies and other workmen were encamped there. As the line had to be pushed on with all speed, a diversion had been made and the river crossed by means of a temporary bridge. My principal work was to erect the permanent structure, and to complete all the other works for a distance of thirty miles on each side of Tsavo. I accordingly made a survey of what had to be done, and sent my requisition for labor, tools and material to the headquarters at Kilindini. Of course the natives of this part of Africa knew nothing about technical work, or indeed work of any kind save carrying a load on the head, so the great majority of our artisans and laborers had to be imported from India. In a short time workmen and supplies came pouring in, and the noise of hammers and sledges, drilling and blasting, echoed merrily throughout the district.

THE FIRST VICTIMS.

Unfortunately this happy state of affairs did not continue for long, and our work was soon interrupted in a rude and startling manner. I had been only a few days at Tsavo when one or two workmen mysteriously disappeared and I was told that they had been carried off from their tents and devoured by lions. At the time I did not credit this story and thought it much

more likely that the unfortunate men were the victims of foul play. They happened to be very good workmen and had saved a fair number of rupees, so I thought it quite likely that some scoundrels from the gangs had murdered them for the sake of their money. This suspicion, however, was very soon dispelled.

I was aroused at dawn one morning by a man who came rushing to my tent to tell me that one of my *jemadars*—a fine, powerful Sikh named Ungan Singh—had been seized during the night and carried off by a huge lion. I immediately caught up my rifle and ran to the spot to find out if the man's story was correct, but the moment I reached the workers' camp I found ample evidence that the gruesome tale was all too true. The lion's "pug" marks were plainly visible in the sand, while the furrows made by the heels of the unfortunate victim showed the direction in which he had been dragged away. Moreover one of the workmen had actually witnessed the whole occurrence which he quaintly and graphically described.

"Sahib," he said, "I was awake and lying next to the *jemadar*, who was asleep, when a big lion put his head in at the open door. My heart turned to water when I saw him so near me, and I could not move. He first looked at me and then at Ungan Singh, and through the kindness of God he took the *jemadar* by the throat instead of your slave. The unfortunate one cried out '*Choro!*' (Let go!), and threw his arm up around the lion's neck, but the great beast dragged him from his bed and carried him off while I lay paralyzed with fear, listening to the terrible struggle which went on outside the tent door. The *jemadar* fought hard, but what chance had he? Was he not fighting with a lion?"

After hearing this vivid account of the tragedy, I at once set out to track the brute and in a short time came up to the spot where he had devoured the unfortunate *jemadar*. Here a dreadful spectacle presented

itself. The ground all about was covered with blood, morsels of flesh, and the larger bones, but the head was left intact, save for a couple of holes made by the lion's tusks. It was the most gruesome sight I had ever seen. It was evident from the marks all around that two lions had been there and had probably fought for possession of the body. I collected the remains as well as possible and buried them under a heap of stones—the horrified, staring eyes of the severed head seeming to watch me all the time, for I did not bury it, but took it back to camp for identification before the medical officer. Before returning I traced the lions for a considerable distance further along the river, but finally lost all trace of them on some hard rocky ground. This was my first experience of the man-eaters and I vowed then and there that I would spare no pains to rid the neighbourhood of the brutes. I little knew the trouble that was in store for me, or how narrow were to be my own escapes from sharing poor Ungan Singh's fate.

That same night I sat up in a tree close to the late *jemadar*'s tent, hoping that the lions would return to it for another victim. I was followed to my perch by a few of the more terrified coolies, who begged to be allowed to sit up in the tree with me; all the other workmen remained in their tents, but no more doors were left open. I had with me my .303 and a 12-bore shotgun, one barrel loaded with ball and the other with slug. Shortly after settling down to my vigil, my hopes of bagging the brutes were raised by the sound of their ominous roaring coming closer and closer. Presently this ceased, and quiet reigned for an hour or two, as lions always stalk their prey in complete silence. All at once, however, we heard a great uproar and frenzied cries coming from another camp about half a mile away; we knew then that the lions had

seized a victim there, and that we should see or hear nothing further of them that night.

Next morning I found that one of the brutes had broken into a tent at Railhead Camp—whence we had heard the commotion during the night—and had made off with a poor wretch who was lying there asleep. After a night's rest, therefore, I took up my position in a suitable tree near this tent. I did not at all like the idea of walking the half-mile to the place after dark, but I felt fairly safe, for one of my men carried a bright lamp close behind me. He in his turn was followed by another leading a goat, which I tied under my tree in the hope that the lion might be tempted to seize it instead of a workman. A steady drizzle commenced shortly after I had settled down to my night of watching, and I was soon thoroughly chilled and wet. I stuck to my uncomfortable post however, hoping to get a shot, but I well remember the feeling of bitter disappointment experienced when about midnight I heard screams and cries and a heartrending shriek, which told me that the man-eaters had again eluded me and had claimed another victim elsewhere.

At this time the various camps of the workmen were very scattered, so the lions had a range of some eight miles on either side of Tsavo to work upon; and as their tactics seemed to be to break into a different camp each night, it was most difficult to forestall them. They appeared to have an extraordinary and uncanny faculty of finding out our plans beforehand, so that no matter in how likely or how tempting a spot we lay in wait for them, they invariably avoided that particular place and seized their victim for the night from some other camp.

Hunting them by day, moreover, in such a dense wilderness as surrounded us, was an exceedingly tiring and really foolhardy undertaking. In a thick jungle of the kind around Tsavo, the hunted animal has every

chance against the hunter, for however careful the latter may be, a dead twig or something of the sort is sure to crackle just at the critical moment and so give the alarm. Still I never gave up hope of some day finding their lair, and accordingly devoted all my spare time to crawling about through the undergrowth. Many a time when attempting to force my way through this bewildering tangle I had to be released by my gun-bearer from the fast clutches of the "wait-a-bit" thorns. Often with immense pains I succeeded in tracing the lions to the river after they had seized a victim, only to lose the trail from there onwards, owing to the rocky nature of the ground which they seemed to be careful to choose in retreating to their den.

At this early stage of the struggle, I am glad to say, the lions were not always successful in their efforts to capture a human being for their nightly meal, and one or two amusing incidents occurred to relieve the tension from which our nerves were beginning to suffer. On one occasion an enterprising *bunniah* (Indian trader) was riding along on his donkey late at night, when suddenly a lion sprang out on him, knocking over both man and beast. The donkey was badly wounded, and the lion was just about to seize the trader, when in some way or other his claws became entangled in a rope by which two empty kerosene tins were strung across the donkey's neck. The rattle and clatter made by these as he dragged them after him gave him such a fright that he turned tail and bolted off into the jungle, to the intense relief of the terrified *bunniah*, who quickly made his way up the nearest tree and remained there, shivering with fear, throughout the night.

Shortly after this episode, a Greek contractor named Themistocles Pappadimitrini had an equally marvellous escape. He was sleeping peacefully in his tent one night, when a lion broke in, and seized and

made off with the mattress on which he was lying. Though rudely awakened, the Greek was quite unhurt and suffered nothing worse than a bad fright. This same man, however, met with a melancholy fate not long afterwards. He had been to the Kilimanjaro district to buy cattle, and on the return journey attempted to take a short cut across country to the railway, but perished miserably of thirst on the way.

On another occasion fourteen coolies, who slept together in a large tent, were one night awakened by a lion's suddenly jumping upon the tent and breaking through it. The brute landed with one claw on a coolie's shoulder, which was badly torn; but, instead of seizing the man himself, in his hurry he grabbed a large bag of rice which happened to be lying in the tent, and made off with it, dropping it in disgust some little distance away when he realized his mistake.

These, however, were only the earlier efforts of the man-eaters. Later on, as will be seen, nothing flurried or frightened them in the least, and save as food they showed a complete contempt of human beings. Having once marked down a victim, they would allow nothing to deter them from securing him, whether he were protected by a thick fence, or inside a closed tent, or sitting round a brightly burning fire. Shots, shouting and firebrands they alike laughed at. Their methods became so uncanny and their man-stalking so well-timed and so certain of success that the workmen firmly believed that they were not real animals at all, but devils in lions' shape.

A MIDNIGHT ATTACK.

All this time I lived in a small tent with no protection of any kind round it, not yet fully realizing the terrible risk I ran. Late one afternoon a medical officer, Dr. Rose, arrived at Tsavo, and I gave him shelter in my quarters. During the night I was awak-

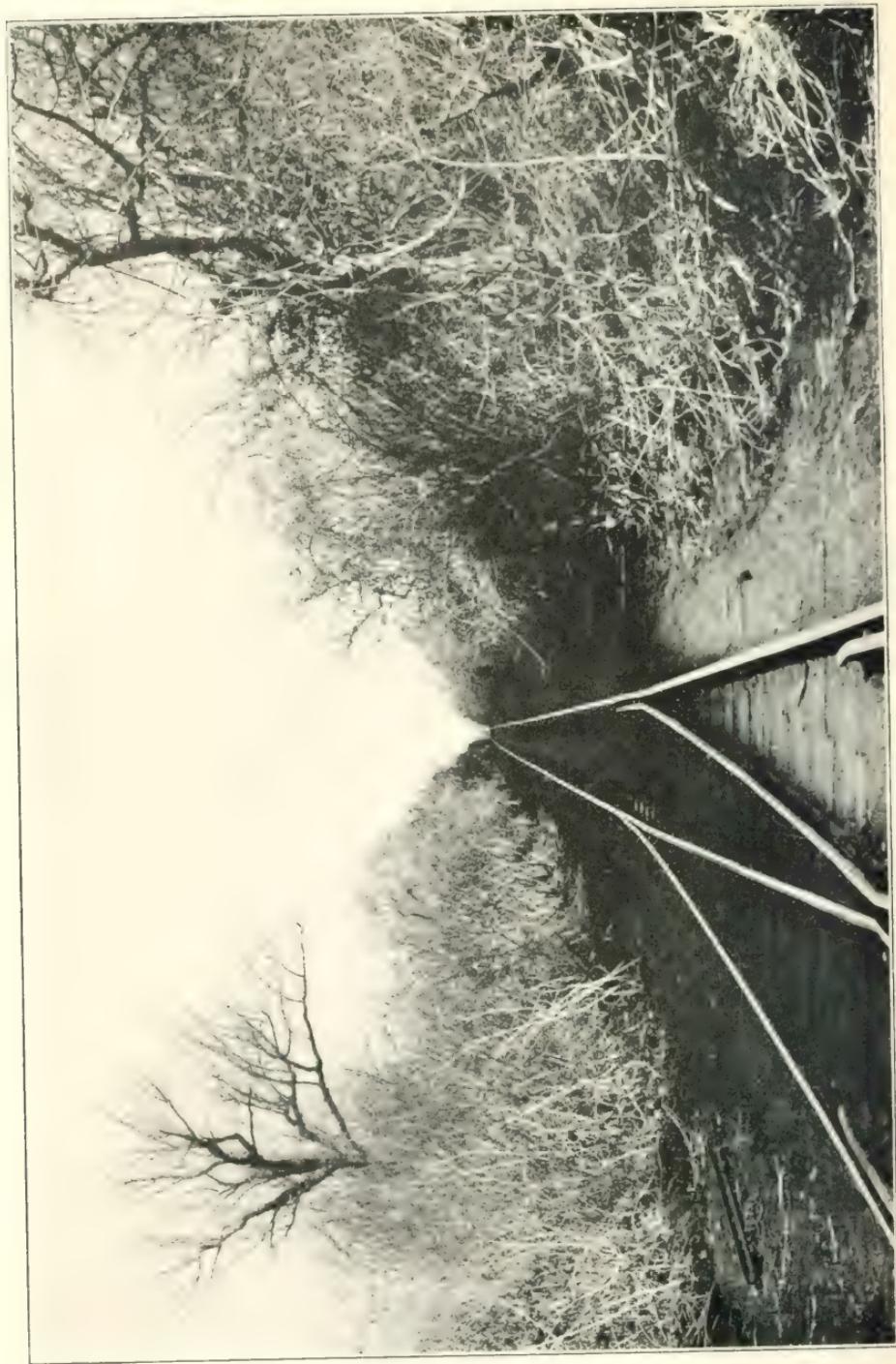
ened by something floundering about among my tent ropes. I shouted out "Who's there?" and this awoke Rose. I at once lit a lantern and we both went out to investigate but could see nothing, so we retired and slept soundly until daylight. In the morning imagine our feelings when we saw the huge "pug" marks of a lion around and around the tent! He had evidently intended to make a meal of one of us, but got entangled in the guy ropes while getting in position for a spring, and this fortunately frightened him away.

It was a very lucky escape for us, and, warned by this experience, I at once changed my quarters and moved to the other side of the river where I shared a hut with my friend, Dr. Brock, who was in medical charge of the district. It was constructed of palm leaves and boughs and was situated on the eastern side of the river, close to the old caravan route leading to Uganda. We had it surrounded by a circular *boma* or thorn fence, about seventy yards in diameter, well made, and thick and high. Our personal servants also lived within the enclosure, and a bright fire was always kept up throughout the night. For the sake of coolness, Brock and I used to sit out under the verandah of this hut in the evenings; but it was rather trying to our nerves to attempt to read or write there, as we never knew when a lion might spring over the *boma*, and be on us before we were aware. We therefore kept our rifles within easy reach, and cast many an anxious glance out into the inky darkness beyond the circle of firelight. On one or two occasions, we found in the morning that the lions had come quite close to the fence; but fortunately they never succeeded in getting through.

By this time, too, the camps of the workmen had also been surrounded by thorn fences; nevertheless the lions managed to jump over or to break through some one or other of these, and regularly every few

nights a man was carried off, the reports of the disappearance of this or that workman coming in to me with painful frequency. So long, however, as Railhead Camp—with its two or three thousand men, scattered over a wide area—remained at Tsavo, the coolies appeared not to take much notice of the dreadful deaths of their comrades. Each man felt, I suppose, that as the man-eaters had such a large number of victims to choose from, the chances of their selecting him in particular were very small. But when the large camp moved farther ahead, matters altered considerably. I was then left with only a few hundred men to complete the permanent works; and as all the remaining workmen were naturally camped together, the attentions of the lions became more apparent and made deeper impression. A regular panic consequently ensued, and it required all my powers of persuasion to induce the men to stay on. In fact, I succeeded in doing so only by allowing them to knock off all regular work until they had built exceptionally thick and high *bomas* round each camp. Within these enclosures fires were kept burning all night, and it was also the duty of the night-watchman to keep clattering half a dozen empty oil tins suspended from a convenient tree. These he manipulated by means of a long rope, while sitting in safety within his tent; and the frightful noise thus produced was kept up at frequent intervals during the night in the hopes of terrifying the man-eaters. In spite of all these precautions, however, the lions would not be denied, and men were nightly dragged out of their tents and devoured.

When the railhead workmen moved on, their hospital camp was left behind. It stood rather apart from the other camps, in a clearing about three-quarters of a mile from my hut, but was protected by a good thick fence and to all appearances was quite secure. It seemed, however, as if barriers were of no avail against



RAILWAY AND THORNY WILDERNESS NEAR TSAVO. (See p. 4.)

the "demons", for before very long one of them found a weak spot in the *boma* and broke through. On this occasion the Hospital Assistant had a marvellous escape. Hearing a noise outside, he opened the door of his tent and was horrified to see a great lion standing a few yards away looking at him. The beast made a spring toward him, which gave the Assistant such a fright that he jumped backwards, and in doing so luckily upset a box containing medical stores. This crashed down with such a loud clatter of breaking glass that the lion was startled for a moment and made off for another part of the enclosure. Here, unfortunately, he was more successful, as he jumped on to and broke through a tent in which eight patients were lying. Two of them were badly wounded in the melee which ensued, and one poor wretch was seized and dragged off bodily through the thorn fence. The two wounded coolies were left where they lay, a piece of torn tent having fallen over them; and in this position the doctor and I found them on our arrival soon after dawn. We at once decided to move the hospital closer to the main camp; a fresh site was prepared, a stout hedge built round the enclosure, and all the patients were moved in before nightfall.

I decided to sit up all night in the vacated *boma* in the hope of getting an opportunity of bagging one of them; but in the middle of my lonely vigil I had the mortification of hearing shrieks and cries coming from the direction of the new hospital, telling me only too plainly that our dreaded foes had once more eluded me. Hurrying to the place at daylight, I found that one of the lions had jumped over the newly erected fence and had carried off the hospital *bhisti* (water-carrier), and that several other coolies had been unwilling witnesses of the terrible scene which took place within the circle of light given by the big camp fire. The *bhisti*, it appears, had been lying on the floor,

with his head toward the center of the tent and his feet nearly touching the side. The lion managed to get its head in below the canvas, seized him by the foot and pulled him out. In desperation the unfortunate water-carrier clutched hold of a heavy box in a vain attempt to prevent himself being carried off, and dragged it with him until he was forced to let go by its being stopped by the side of the tent. He then caught hold of a tent rope and clung tightly to it until it broke. As soon as the lion managed to get him clear of the tent, he sprang at his throat and after a few vicious shakes the poor *bhisti's* agonized cries were silenced forever. The brute then took him in his mouth and, like a huge cat with a mouse, ran up and down the *boma*, looking for a weak spot to break through. This he presently found and plunged into, dragging his victim with him and leaving shreds of torn cloth and flesh as ghastly evidences of his passage through the thorns. Dr. Brock and I were easily able to follow his track, and soon found the remains about four hundred yards away in the bush. There was the usual horrible sight. Very little was left of the unfortunate *bhisti*—only the skull, the jaws, a few of the larger bones and a portion of the palm with one or two fingers attached. On one of these was a silver ring, and this, with the teeth (a relic much prized by certain castes), was sent to the man's widow in India.

Again it was decided to move the hospital and a still higher and stronger *boma* was built round the new site. The work was completed and all patients carried in before nightfall. As I knew that lions were in the habit of prowling round deserted camps, I asked my friend, Brock, to join me and watch for the man-eater near the vacated hospital enclosure. A railway track ran beside it, so I had a covered freight car shunted to the entrance and in this we took up our position at nightfall, sitting on a couple of boxes just

inside the open doorway. When I now think of the foolhardiness of this procedure, it makes me shudder, but at that time I did not realize the danger we ran or that the man-eater would be so audacious as to look upon us as a tempting tit-bit for his hungry maw.

I had put some cattle into the deserted hospital enclosure and left a few tents standing, so that the lions might be deceived and think that the patients were still within the *boma*. We sat in the car for a couple of hours in perfect silence enveloped in Stygian darkness, and then I plainly heard a dry stick snap. "The Man-Eater!" I whispered to Brock. A few minutes afterwards we heard a dull thud as if some heavy body had jumped over the *boma*. Then we heard the cattle running about. After that everything became still.

I now proposed to my companion that I should climb out of the car and lie on the ground, so as to get a better shot at the brute, if he should come in our direction with his prey; but Brock persuaded me to remain where I was and, thank God, I took his advice, for, at that very moment the lion was actually stalking us. After a short period of intense gazing into the darkness, I thought I saw something glide to a bush in front of us. In a whisper I asked Brock, "Did you see anything move?" but he made no reply, so I held my rifle in readiness and waited. Those two or three moments I shall never forget. I felt instinctively that the uncanny devil was stealing stealthily toward us and I even thought I could discern a form of some kind, but I feared to fire lest it should be only my imagination running away with me, and in that case I should merely frighten the man-eater away. The darkness and silence could almost be felt and for those few seconds the strain on my nerves was almost unendurable. Then—suddenly—a huge body sprang at us. "The lion!" I shouted, and both our shots rang

out simultaneously. The noise and flash of our rifles so terrified the brute that, instead of leaping right into the car, he turned in his spring, but he got so close to me that I felt the wipe of his paw across my face. If we had not been thoroughly on the alert, he would undoubtedly have got one of us. We fired a few more shots into the darkness in order to prevent a second attack, and then lit a lantern and, while I got out to close the door—trembling all the time lest the man-eater should grab me—Brock stood ready to shoot.

We had the luckiest escape that night that it is possible for man to experience. Only our keen vigilance and God's good providence saved one or both of us from an awful fate. Next morning we found Brock's bullet embedded in the sand, close to a footprint; it could not have missed the lion by more than an inch or two. Mine was nowhere to be found. Later on I found that my bullet had shot away one of the lion's tusks, as may be seen on examining the head.

THE LIONS HOLD UP THE RAILWAY.

The lions apparently got a very bad fright the night Brock and I gave them such a warm reception in the freight car, for they kept away from Tsavo and did not molest us in any way for some time. During the breathing space which they vouchsafed us, it occurred to me that, if they should renew their attacks, a trap would perhaps offer the best method of getting to grips with them, and if I could construct one in which a couple of coolies might be used as bait without being subjected to any danger, the lions would be quite daring enough to enter it in search of them and thus be caught. I accordingly set to work at once, and in a short time managed to make a sufficiently strong trap out of wooden sleepers, tram-rails, pieces of telegraph wire, and a length of heavy chain. It was divided into two compartments—one for the men

and one for the lion. A sliding door at one end admitted the former, and once inside this compartment they were perfectly safe, for between them and the lion, if he should attack them, ran a cross wall of iron rails only three inches apart, and embedded both top and bottom in heavy wooden sleepers. The door which was to admit the lion was, of course, at the opposite end of the structure, but otherwise the whole thing was very much on the principle of the ordinary rat-trap, except that it was not necessary for the lion to seize the bait in order to send the door clattering down. This part of the contrivance was arranged in the following manner. A heavy chain was secured along the top part of the lion's doorway, the ends hanging down to the ground on either side of the opening; and to these were fastened, strongly secured by stout wire, short lengths of rails placed about six inches apart. This made a sort of flexible door which could be packed into a small space when not in use, and which abutted against the top of the doorway when lifted up. The door was held in this position by a lever made of a piece of rail, which in turn was kept in its place by a wire fastened to one end and passing down to a spring concealed in the ground inside the cage. As soon as the lion entered sufficiently far into the trap, he would be bound to tread on the spring; his weight on this would release the wire, and in an instant down would come the door behind him; and he could not push it out in any way, as it fell through a groove between two rails firmly embedded in the ground.

In making this trap, which cost us a lot of work, we were rather at a loss for want of tools to bore holes in the rails for the doorway, so as to enable them to be fastened by the wire to the chain. It occurred to me, however, that a hard-nosed bullet from my .303 would penetrate the iron, and, on making the experi-

ment, I was glad to find that a hole was made as cleanly as if it had been punched out.

When the trap was ready, I pitched a tent over it in order further to deceive the lions, and built an exceedingly strong *boma* round it. One small entrance was made at the back of the enclosure for the men, which they were to close on going in by pulling a bush after them; and another entrance just in front of the door of the cage was left open for the lions. The wiseacres to whom I showed my invention were generally of the opinion that the man-eaters would be too cunning to walk into my parlour; but, as will be seen later, their predictions proved false. For the first few nights I baited the trap myself, but nothing happened except that I had a very sleepless and uncomfortable time, and was badly bitten by mosquitoes.

As a matter of fact, it was some months before the lions attacked us again, though from time to time we heard of their depredations in other quarters. Not long after our night in the freight car, two men were carried off from the railhead, while another was taken from a place called Engomani, about ten miles away. Within a short time, this latter place was again visited by the brutes, two more men being seized, one of whom was killed and eaten, and the other so badly mauled that he died within a few days. As I have said, however, we at Tsavo enjoyed complete immunity from attack, and the coolies, believing that their dreaded foes had permanently deserted the district, resumed all their usual habits and occupations, and life in the camps returned to its normal routine.

At last we were suddenly startled out of this feeling of security. One dark night the familiar terror-stricken cries and screams awoke the camps, and we knew that the "demons" had returned and had commenced a new list of victims. On this occasion a

number of men had been sleeping outside their tents for the sake of coolness, thinking, of course, that the lions had gone for good, when suddenly in the middle of the night one of the brutes was discovered forcing its way through the *boma*. The alarm was at once given, and sticks, stones and firebrands were hurled in the direction of the intruder. All was of no avail, however, for the lion burst into the midst of the terrified group, seized an unfortunate wretch amid the cries and shrieks of his companions, and dragged him off through the thick thorn fence. He was joined outside by the second lion, and so daring had the two brutes become that they did not trouble to carry their victim farther away, but devoured him within thirty yards of the tent where he had been seized. Although several shots were fired in their direction by the *jemadar* of the gang to which the coolie belonged, they took no notice of these and did not attempt to move until their horrible meal was finished. The few scattered fragments that remained of the body I would not allow to be buried at once, hoping that the lions would return to the spot the following night; on the chance of this I took up my station at nightfall in a convenient tree. Nothing occurred to break the monotony of my watch, however, except that I had a visit from a hyena, and the next morning I learned that the lions had attacked another camp about two miles from Tsavo—for by this time the camps were again scattered, as I had works in progress all up and down the line. There the man-eaters had been successful in obtaining a victim, whom, as in the previous instance, they devoured quite close to the camp. How they forced their way through the *bomas* without making a noise was, and still is, a mystery to me; I should have thought that it was next to impossible for an animal to get through at all. Yet they continually did so, and without a sound being heard.

After this occurrence, I sat up every night for over a week near likely camps, but all in vain. Either the lions saw me and then went elsewhere, or else I was unlucky, for they took man after man from different places without ever once giving me a chance of a shot at them. This constant night watching was most dreary and fatiguing work, but I felt that it was a duty that had to be undertaken, as the men naturally looked to me for protection. In the whole of my life I have never experienced anything more nerve-shaking than to hear the deep roars of these dreadful monsters growing gradually nearer and nearer, and to know that someone or other of us was doomed to be their victim before the morning dawned. Once they reached the vicinity of the camps, the roars completely ceased, and we knew they were stalking their prey. Shouts would then pass from camp to camp, "*Khabar dar, bhaieon, shaitan ata!*" (Beware, brothers, the devil is coming!), but the warning cries would prove of no avail, and sooner or later agonizing shrieks would break the silence and another man would be missing from roll-call next morning.

I have a very vivid recollection of one particular night when the brutes seized a man from the railway station and brought him close to my camp to devour. I could plainly hear them crunching the bones, and the sound of their dreadful purring filled the air and rang in my ears for days afterwards. The terrible thing was to feel so helpless; it was useless to attempt to go out, as of course the poor fellow was dead, and in addition it was so pitch dark as to make it impossible to see anything. Some half a dozen workmen, who lived in a small enclosure close to mine, became so terrified on hearing the lions at their meal that they shouted and implored me to allow them to come inside my *boma*. This I willingly did, but soon afterwards I remembered that one man had been lying ill in their

camp, and on making inquiry I found that they had callously left him behind alone. I immediately took some men with me to bring him to my *boma*, but on entering his tent I saw by the light of the lantern that the poor fellow was beyond need of safety. He had died of shock at being deserted by his companions.

From this time on matters gradually became worse. Almost every morning some workmen or other would come to my tent to tell me of a raid he had witnessed when one of his comrades had been carried off. One day an Indian artisan who had been acting as watchman came to my tent, still shivering with fear, to report what had occurred during the night. In the early hours of the morning, he said, he was sitting on top of a high pile of wooden sleepers when he saw the man-eater, silent as a ghost, emerge from the jungle, and stalk toward a truck where some of his comrades were sleeping. Instantly he gave a warning cry, shouting as loudly as possible and at the same time rattling some empty kerosene tins which he had with him for the purpose. On hearing the noise, the lion dived for cover under some wagons. The startled workmen jumped up and looked round in all directions but could see no trace of the man-eater. The brute had quietly slipped under a train, the engine of which happened to be taking water at a siding, and presently the watchman saw him standing in front of an open car in which a sick engineer, on his way to the coast, was lying. The man-eater was just gathering himself for a spring at the invalid, when the fireman by a lucky chance threw some slag out of his fire-box on to a heap of rails that happened to be stacked there, and this scared the brute away for the moment.

He presently reappeared, however, beside the truck in which the workmen whom he had first stalked were lying and, before the watchman had time to utter another warning cry, he had leaped in amongst them

and seized his victim. Shaking the unfortunate man as a terrier would a rat, he carried him off shrieking, and devoured him not two hundred yards away in the depths of the gloomy jungle.

Hitherto as a rule, only one of the man-eaters had made the attack and had done the foraging, while the other waited outside in the bush; but now they began to change their tactics, entering the *bomas* together and each seizing a victim. In this way two Swahili porters were killed, one being immediately carried off and devoured. The other was heard moaning for a long time, and when his terrified companions at last summoned up sufficient courage to go to his assistance, they found him stuck fast in the bushes of the *boma*, through which for once the lion had apparently been unable to drag him. He was still alive when I saw him next morning, but so terribly mauled that he died before he reached the hospital.

Within a few days of this, the two brutes made a most ferocious attack on the largest camp in the section, which for safety's sake was situated within a stone's throw of Tsavo Station and close to a Permanent Way Inspector's iron hut. Suddenly in the dead of night, the two man-eaters burst in among the terrified workmen, and even from my *boma*, some distance away, I could plainly hear the panic-stricken shrieking of the coolies. Then followed cries of "They've taken him; they've taken him!" as the brutes carried off their unfortunate victim and began their horrible feast close beside the camp. The Inspector, Mr. Dalgairns, fired over fifty shots in the direction in which he heard the lions, but they were not to be frightened and calmly lay there until their meal was finished. After examining the spot in the morning, we at once set out to follow the brutes, Mr. Dalgairns feeling confident that he had wounded one of them, as there was a trail on the sand like that of the toes of a broken limb. After

some careful stalking, we suddenly found ourselves in the vicinity of the lions and were greeted with ominous growlings. Cautiously advancing and pushing the bushes aside, we saw in the gloom what we at first took to be a lion cub; closer inspection, however, showed it to be the remains of the unfortunate coolie, which the man-eaters had evidently abandoned at our approach. The legs, one arm and half of the body had been eaten, and it was the stiff fingers of the other arm trailing along the sand which had left the marks we had taken to be the trail of a wounded lion. By this time the beasts had retired far into the thick jungle where it was impossible to follow them, so we had the remains of the coolie buried and once more returned home disappointed.

Now the bravest men in the world, much less the ordinary Indian coolie, will not stand constant terrors of this sort indefinitely. The whole district was by this time thoroughly panic-stricken and I was not at all surprised, therefore, to find on my return to camp that same afternoon, that the men had all struck work and were waiting to speak to me. When I sent for them, they flocked to my *boma* in a body and told me that they would not remain at Tsavo any longer for anything or anybody; they stated that they had "come from India on an agreement *to work* for the Government, not *to supply food* for either lions or devils." No sooner had they delivered this ultimatum than a regular stampede took place. Some hundreds of them stopped the first passing train by throwing themselves prostrate on the rails in front of the engine, and then, swarming on to the flat-cars, they fled from the accursed spot.

ABDULLAH'S TRAGIC FATE.

After the flight of the workmen, the building of the railway in the neighborhood of Tsavo was com-

pletely stopped, and for some weeks practically nothing was done but erect "lion proof" huts for those few stout-hearted fellows who had sufficient courage to remain. It was a strange and amusing sight to see men perched on the top of water-tanks, roofs and girders —anywhere for safety. One enterprising coolie made a three story apartment on a water tank which he rented out at great profit to himself; others dug out pits inside their tents into which they descended at night, covering the top over with heavy logs of wood. Every good-sized tree in the camp had as many beds lashed to it as it would bear. I remember that one night when the camp was attacked, so many men swarmed up one particular tree that it came down with a crash, hurling its terror-stricken load of shrieking coolies close to the very lions they were trying to avoid. Fortunately for them, however, the man-eaters had already seized a victim and they were so busy devouring him that they paid no attention to anything else.

About this time I invited Mr. Whitehead, the District Officer who lived some thirty miles away, to come and assist me in my campaign against the man-eaters. He accepted the invitation and told me to expect him towards evening in time for dinner. His train was due at six o'clock, so I sent my Indian servant up to the station to meet him. In a short time he came rushing back, trembling with terror, to inform me that there was no sign of the train or of any of the railway staff, but that a big lion was walking up and down the platform. "Nonsense," I replied, "it is probably a jackal," for I did not for a moment believe his story. Everybody was in such a state of panic that, if even a squirrel had been seen on the platform, it would have been magnified into a lion. As a matter of fact I found out next morning that my servant's story was perfectly true, and both the Station Master and his men had

been obliged to take refuge from the man-eater by locking themselves in the station building.

As Whitehead did not turn up, I ate my dinner alone. During the course of the meal I heard the report of a couple of shots, but I paid no heed to them, for guns had been issued to the headmen of the gangs to scare away the lions, and shooting was a common occurrence after nightfall.

Shortly after dusk I went out and took up my position on a crib made of sleepers, perched on the end of a girder. Soon after settling down at my post, I was surprised to hear the man-eaters growling and purring and crunching up bones about seventy yards from where I was sitting. I could not understand what they had found to eat, for I had heard no commotion in the camps, and I knew by bitter experience that every meal the brutes obtained was announced by shrieks and uproar. The only conclusion I could come to was that they had pounced upon some poor unsuspecting native traveller. After a time I was able to make out their eyes glowing in the darkness, so I took as careful aim as possible and fired. The only notice they took was to carry off whatever they were eating and retire quietly over a slight ridge which hid them from my view. As soon as it was daylight, I got out of my crib and went towards the place where I had heard the growling and on the way, whom should I meet but my missing guest, Mr. Whitehead, looking very pale and ill and generally dishevelled.

"Where on earth have you come from?" I exclaimed. "Why didn't you turn up to dinner last night?"

"A nice reception you give a fellow when you invite him to dinner," was his reply.

"Why, what's up?" I asked.

"That infernal lion of yours jumped on me and nearly did for me last night," said Whitehead.

"Nonsense!" I cried in astonishment, "you must have dreamt it."

"That's not much of a dream, is it?" he asked, turning round and showing me his back.

His clothing was rent by one huge tear from the nape of his neck downwards, and on the bare flesh there were four great claw marks showing red and angry through the torn cloth.

Without further parley I hurried him off to my tent, where I bathed and dressed his wounds, and, when I had made him considerably more comfortable, I got from him the whole story of the events of the night. It appeared that his train was very late, so it was quite dark when he arrived at Tsavo station. He set out on foot along the railway to my camp, accompanied by Abdullah his sergeant of Askaris (native police), who walked close behind him carrying a lighted lantern. All went well until they were about half-way through a gloomy cutting, when the man-eater suddenly jumped down on them from the high bank, knocking Whitehead over like a ninepin and tearing his back in the manner I have described. Fortunately, however, my friend had his rifle with him and instantly fired. The flash and the loud report must have dazed the lion for a second or two, enabling Whitehead to disengage himself; but the next instant the brute pounced like lightning on the unfortunate Abdullah with whom he at once bounded up the bank and made off into the bush. All that the poor fellow could say was, "Eh, bwana, simba" (Oh, master, a lion.)

THE LION TRAPPED.

On the day following poor Abdullah's tragic death, the forces arrayed against the man-eaters were further increased. Mr. Farquhar, the Superintendent of Police, arrived from the coast with a score of sepoy (Indian soldiers) to assist in hunting down the lions whose

fame had by this time spread far and wide. We made elaborate plans for a combined offensive against the man-eaters and posted men on the most convenient trees near every camp. Several other officials also came up on leave to join in the chase and each of these guarded a likely spot in the same way, Mr. Whitehead sharing my post inside the crib on the girder. Also my lion trap was put into thorough working order, and two of the sepoy's were installed as bait. Our preparations were quite complete by nightfall, when we took up our appointed positions.

Nothing happened until about 9 o'clock when, to my great satisfaction, the intense stillness was suddenly broken by the noise of the door of the lion trap clattering down.

"By Jove, Whitehead!" I exclaimed, "one of them is caught."

But, alas, for my hopes, the sequel proved an inglorious one. The bait-sepoys had a lamp burning inside their part of the cage, and were each armed with a Martini rifle and provided with plenty of ammunition. They had been given strict orders to shoot at once if a lion should enter the trap. Instead of doing so, however, they were so terrified when the ferocious beast rushed at them and finding himself trapped began to lash himself madly against the bars of the cage, that they completely lost their heads and were actually too unnerved to fire. Not for some minutes—not indeed until Farquhar, whose post was close by, shouted at them and cheered them on—did they at all recover themselves. Then, when at last they did begin to shoot, they shot with a vengeance, anyhow, anywhere,—except at the lion! Whitehead and I were at right angles to the direction in which they should have fired, and yet their bullets came whizzing all round us. Altogether they fired over a score of shots and in the end succeeded in blowing

away one of the bars of the cage, and through this opening the man-eater calmly walked out! How they failed to kill him several times over, is, and always will be, a complete mystery to me, for they could actually have put the muzzles of their rifles on to the lion's body.

Of course, after this fiasco, the men were more firmly convinced than ever that we were at grips with the Devil himself. We were not unduly dejected, however, and when morning dawned a hunt was at once arranged. Accordingly we spent the greater part of the day on our hands and knees endeavoring to track the lions through the dense thickets of thorny jungle, but, though we heard their growls from time to time, we never succeeded in coming up with them. Indeed, of the whole party only Farquhar managed to catch a glimpse of one as it bounded over a bush. Two more days were spent in the same manner and with equal lack of success, and then Farquhar and his sepoy were obliged to return to the coast. Mr. Whitehead also departed for his district, and once again I was left alone with the man-eaters.

VICTORY AT LAST.

A day or two after the departure of my allies, as I was leaving my *boma* soon after dawn, I saw a native running excitedly toward me shouting out "Simba, bwana, simba!" (The lion, master, the lion!), and every now and then looking behind him as he ran. On questioning him, I found that one of the man-eaters had tried to break into the camp by the river, but, being foiled in this, had just seized and killed a donkey and was at that moment devouring it in the jungle close at hand.

Now was my chance. I rushed for the heavy rifle which Farquhar had left me in case an opportunity such as this should arise, and then, led by the



COOLIES AT ENTRANCE OF THEIR BOMA. (See p. 12.)



TENT FROM WHICH MAN WAS TAKEN. (See p. 22.)

Swahili, I started off with the fervent hope that the Lord would deliver the man-eater into my hands. My pulse was beating much faster than usual, as I carefully stalked the dreaded beast. I crouched and crawled from bush to bush, very anxious lest I should be discovered. In a short time I had the satisfaction of hearing him crunching up the donkey's bones and then, after a further short stalk, I saw the head of the lion faintly outlined in the undergrowth, but some uncanny influence seemed to guard this demon, for, as I was taking a careful bead on him, my guide put his foot on a rotten branch, and the wary beast, hearing the noise, growled his defiance and, before I had time to press the trigger, disappeared into a patch of thick jungle.

In desperation at the thought of his escaping me once again, I ran back to camp, summoned all the available workmen and told them to bring every tom-tom, flute, tin can and other noisy instrument that could be found. As quickly as possible I posted them in a half circle as near as was safe to the spot where the lion was hiding, and gave the head *jemadar* instructions to start a simultaneous shouting and beating of the tom-toms and cans, as soon as I had time to get around to the other side. I then circled rapidly behind the lion where I found a good position beside an ant-hill which the brute was very likely to pass when he left his hiding place, for it was in the middle of a broad animal path leading straight from his lair. I knelt behind the ant-hill and waited expectantly.

Soon I heard a tremendous din being raised by the advancing workmen and, almost immediately, to my intense joy, out into the open path stepped a huge maneless lion. It was the first time, during all these trying months, that I had obtained a fair chance of a shot and my satisfaction at the prospect of bagging the man-eater was unbounded. Slowly and very

majestically he advanced along the path, stopping every few seconds to look round. I was fascinated at the sight and remained motionless as a statue. I was only partly concealed from view, and, if his attention had not been so fully occupied by the noise behind him, he must have observed me. As he was oblivious to my presence, however, I let him approach to within about fifteen yards of me and then quickly covered him with my rifle. The moment I moved the weapon, he caught sight of me and seemed very much astonished at my sudden appearance, for he stuck his forefeet into the ground, threw himself back on his haunches, opened his jaws wide and growled savagely. As I sighted the rifle on his brain I felt that, at last, I had him absolutely at my mercy but—never trust an untried weapon! I pressed the trigger and, to my horror, heard the dull snap that tells of a misfire! Fortunately for me the lion was so distracted by the terrific din and uproar made by the coolies behind him that instead of springing upon me as I expected, he bounded aside into the jungle and once more escaped. Bitterly did I anathematise the hour in which I had relied upon a borrowed weapon, and in my vexation I abused owner, maker, and rifle with fine impartiality.

After this dismal failure there was, of course, nothing to do but return to camp. Before doing so, however, I proceeded to view the dead donkey which I found to have been only partly eaten at the quarters. It is a curious fact that lions always begin at the tail end of their prey and eat upwards toward the head. As his meal had thus been interrupted, evidently at the very beginning, I felt pretty sure that the hungry brute would return to the carcass at nightfall. Accordingly, as there was no suitable tree close at hand, I had a staging erected some ten feet away from the dead animal. This *machan* was about twelve feet high

and was composed of four poles stuck into the ground and inclined toward each other at the top, where a plank was lashed to serve as a seat. Further, as the nights were still pitch dark, I had the donkey's carcass secured by strong wires to a neighboring stump, so that the lion might not be able to drag it away before I could get a shot at him.

At sundown I took up my position on the flimsy perch and, much to the disgust of my gun-bearer, Ma-hina, I decided to go alone. I would gladly have taken him with me, indeed, but he had a bad cough and I was afraid lest he should make any involuntary noise or movement which might spoil all. Darkness fell almost immediately and everything became extraordinarily still. The silence of an African jungle on a dark night needs to be experienced to be realized. It is most impressive, especially when one is absolutely alone and isolated from his kind. The solitude and stillness, and the purpose of my vigil, all had their effect on me, and from a condition of strained expectancy, I gradually fell into a dreamy mood which harmonized well with my surroundings. Suddenly I was startled out of my reverie by the snapping of a twig, and, straining my ears for a further sound, I fancied that I could hear the rustling of a large body forcing its way through the bush. "The Man-eater!" I thought to myself, "surely tonight my luck will change and I shall bag one of the brutes." Profound silence again followed. I sat on my perch like a statue, every nerve tense with excitement. Very soon all doubt as to the presence of the man-eater was dispelled. A deep long-drawn sigh—sure sign of hunger—came up from the bushes, and the rustling commenced again, as he cautiously advanced. In a moment or two a sudden stop, followed by an angry growl, told me that my presence had been noticed, and I began to fear that disappointment awaited me once more. But no;

events now took a turn which made my blood run cold, for, instead of either making off, or coming for his kill, the lion began stealthily to stalk me!

For about two hours he horrified me by slowly creeping round and round my crazy structure, gradually edging his way nearer and nearer. Every moment I expected him to rush the staging; and it had not been constructed with an eye to such a possibility. If one of the rather flimsy poles should break, or if the lion could spring the twelve feet which separated me from the ground . . . the thought was not a pleasant one. I remember saying to myself, "There is a dead donkey down there, but if ever there was a real live one, here he sits." I began to feel distinctly "creepy" and heartily repented my folly in having placed myself all alone in such a dangerous position. I kept perfectly still, hardly daring even to blink my eyes, but the long continued strain began to tell on my nerves; and my feelings can better be imagined than described, when just about midnight something came flop and hit me on the back of the head. For a moment I was so terrified that I nearly fell off the plank, for I thought that the lion had sprung on me from behind. Regaining my senses in a second or two, I realized that I had been hit by nothing more formidable than an owl, which had doubtless mistaken me for the branch of a tree. Not a very alarming thing to happen in ordinary circumstances, I admit, but coming at the time it did, it almost paralyzed me. The involuntary start, which I could not help giving, was immediately answered by a sinister growl from below. After this I again kept as still as I could, though by this time I was actually trembling with excitement and nerves. In a short time I heard the lion begin to creep toward me. I could barely make out his form, as he crouched among the whitish undergrowth, but I saw enough for my purpose, and before he could come

any nearer I took careful aim and fired. The sound of the shot was at once followed by a terrific roar and then I could hear him leaping about in all directions. I was no longer able to see him, for his first bound had taken him into the thick bush, but, to make assurance doubly sure, I kept blazing away in the direction in which I heard him plunging about. At length came a series of mighty groans, gradually subsiding into deep sighs, and finally ceasing altogether, and I then knew that one of the "devils" who had so long harried us would trouble us no more.

As soon as I ceased firing, a tumult of enquiring voices was borne across the dark jungle from the men in camp about quarter of a mile away. I shouted back that I was safe and sound and that the lion was dead. Whereupon such a mighty cheer went up from all the camps as must have frightened the denizens of the jungle for miles around. Soon I saw scores of lights twinkling through the bushes. Every man in camp turned out, and, with tom-toms beating and horns blowing came running to the scene. They surrounded my perch, and—to my amazement—prostrated themselves on the ground before me, saluting me with cries of "Mabarak! Mabarak!" which means "Blessed one" or "Saviour." I refused to allow any search for the body of the lion to be made, in case he might possibly be shamming dead. Accordingly we all returned in triumph to the camp, where great rejoicings were kept up for the remainder of the night, the Swahili and other African natives celebrating the occasion by an exceptionally wild and savage dance.

For my part, I anxiously awaited the dawn, and even before it was thoroughly light, I was on my way to the eventful spot, for I could not completely persuade myself even yet that "the devil" might not have eluded me in some uncanny and mysterious way. Happily my fears proved groundless, and I was greatly

relieved to find that my luck—after playing me so many exasperating tricks—had really turned at last. I had scarcely traced the blood for more than a few paces when, on rounding a bush, I was startled to see a huge lion right in front of me, seemingly alive and crouching for a spring. On looking closer, however, I satisfied myself that he was really and truly stone dead, whereupon my followers crowded round, laughed and danced and shouted with joy like children, and bore me in triumph shoulder-high round the dead body. When these thanksgiving ceremonies were over, I examined my trophy and found that it was indeed one to be proud of. His length from tip of nose to tip of tail was nine feet eight inches; he stood three feet, nine inches high, and it took eight men to carry him back to camp. On examining his head, I found that a .303 bullet had smashed out one of his tusks, for the track of the bullet was left in the tooth stump. I must have given him a bad toothache the night he attacked Brock and myself in the freight car.

THE END OF THE MAN-EATERS.

It must not be imagined that with the death of this lion our troubles at Tsavo were at an end; his companion was still at large, and very soon began to make us unpleasantly aware of the fact. Only a few nights elapsed before he made an attempt to get at the Permanent Way Inspector, climbing up the steps of his bungalow and prowling round the verandah. Mr. Dalgairns, hearing the noise and thinking it was a drunken coolie, shouted angrily, "Go away!" but, fortunately for him, did not attempt to come out or to open the door. Thus disappointed in his attempt to obtain a meal of human flesh, the lion seized a couple of the Inspector's goats and devoured them there and then.

On hearing of this occurrence, I determined to sit up the next night near the Inspector's bungalow. Fortunately there was a vacant iron shanty close at hand, with a convenient loophole in it for firing from; and outside this I placed three full-grown goats as bait, tying them to a half length of rail, weighing about 250 lbs. The night passed uneventfully until just before daybreak, when at last the lion turned up, pounced on one of the goats and made off with it, at the same time dragging away the others, rail and all. I fired several shots in his direction, but it was pitch dark and quite impossible to see anything, so I only succeeded in hitting one of the goats.

Next morning I started off in pursuit and was joined by some others from the camp. The trail of the goats and rail was easily followed, and we soon came up, about a quarter of a mile away, to where the lion was still busy at his meal. He was concealed in some thick scrub and growled angrily on hearing our approach; finally, as we got closer, he suddenly made a charge, rushing through the bushes at a great pace. In an instant, every man of the party scrambled hastily up the nearest tree, with the exception of one of my assistants, Mr. Winkler, who stood steadily by me throughout. The brute, however, did not press his charge home; and on throwing stones into the bushes where we had last seen him, we guessed by the silence that he had slunk off. We, therefore, advanced cautiously, and, on getting up to the place, discovered that he had indeed escaped us, leaving two of the goats scarcely touched.

Thinking that in all probability the lion would return as usual to finish his meal, I had a very strong scaffolding put up a few feet away from the dead goats, and took up my position on it before dark. On this occasion I brought my gun-bearer, Mahina, to take a turn at watching, as I was by this time worn

out for want of sleep, having spent so many nights on the lookout. I was just dozing off comfortably, when suddenly I felt my arm seized, and, on looking up, saw Mahina pointing in the direction of the goats. "Sher!" (Lion) was all he whispered. I grasped my smooth-bore, which I had double-charged with slug, and waited patiently. In a few moments I was rewarded, for, as I watched the spot where I expected the lion to appear, there was a rustling among the bushes, and I saw him stealthily emerge into the open and pass almost directly beneath us. I fired both barrels practically together into his shoulder, and, to my joy, could see him go down under the force of the blow. Quickly I reached for the magazine rifle, but, before I could use it, he was up again and out of sight among the bushes, and I had to fire after him quite at random. Nevertheless I was confident of getting him in the morning, and accordingly set out as soon as it was light. For over a mile there was no difficulty in following the blood trail, and, as he had rested several times, I knew that he had been badly wounded. In the end, however, my hunt proved fruitless, for after a time the traces of blood ceased and the surface of the ground became rocky, so that I was no longer able to follow the spoor.

As it happened, there was no sign of our enemy for about ten days after this, and we began to hope that he had died of his wounds in the bush. All the same we still took every precaution at night, and it was fortunate that we did so, for otherwise at least one more victim would have been added to the list. I was suddenly aroused one night by terrified shouts from my trolley men, who slept in a tree close outside my *boma*; they were crying out that the lion was trying to get at them. It would have been madness to have gone out, as the moon was hidden by dense clouds and it was absolutely impossible to see any-

thing more than a yard ahead, so all I could do was to fire off a few rounds just to frighten the brute away. This apparently had the desired effect, for the men were not further molested that night; but the man-eater had evidently prowled about for some time, for we found in the morning that he had gone right into every one of their tents, and round the tree was a regular ring of his footmarks.

The following evening I took up my position in this same tree, in the hope that he would make another attempt. The night began badly, for, while climbing up to my perch, I very nearly put my hand on a venomous snake which was lying coiled round one of the branches. As may be imagined, I came down again very quickly, but one of my men managed to despatch it with a long pole. Fortunately the night was clear and cloudless, and the moon made everything almost as bright as day. I kept watch until about 2 A. M., when I roused Mahina to take his turn. For about an hour I slept peacefully with my back to the tree, and then woke suddenly with an uncanny feeling that something was wrong. Mahina, however, was on the alert, and had seen nothing; and, although I looked carefully round us on all sides, I too could discover nothing unusual. Only half satisfied, I was about to lie back again, when I fancied I saw something move a little way off among the low bushes. On gazing intently at the spot for a few seconds, I found I was not mistaken. It was the man-eater, cautiously stalking us.

The ground was fairly open round our tree, with only a small bush here and there; and from our position it was a most fascinating sight to watch this great brute stealing stealthily round us, taking advantage of every bit of cover as he came. His skill showed that he was an old hand at the terrible game of man-hunting, so I determined to run no undue risk

of losing him this time. Accordingly I waited until he got quite close—about twenty yards away—and then fired my .303 at his chest. I heard the bullet strike him, but unfortunately it had no knockdown effect, for, with a fierce growl, he turned and made off with great long bounds. Before he disappeared from sight, however, I managed to have three more shots at him from the magazine rifle, and another growl told me that the last of these had also taken effect.

We awaited daylight with impatience, and at the first glimmer of dawn set out to hunt him down. I took a native tracker with me, so that I was free to keep a good lookout, while Mahina followed immediately behind with a Martini carbine. Splashes of blood being plentiful, we were able to get along quickly and we had not proceeded more than a quarter of a mile through the jungle when suddenly a fierce warning growl was heard right in front of us. Looking cautiously through the bushes, I could see the man-eater glaring out in our direction, and showing his tusks in an angry snarl. I at once took careful aim and fired. Instantly he sprang out and made a most determined charge down on us. I fired again and knocked him over, but in a second he was up once more and coming for me as fast as he could in his crippled condition. A third shot had no apparent effect, so I put out my hand for the Martini hoping to stop him with the heavy lead bullet. To my horror, however, the rifle was not there. The terror of the sudden charge had proved too much for Mahina, and both he and the carbine were by this time well on their way up a tree. In the circumstances there was nothing to do but follow suit, which I did without loss of time, and, but for the fact that one of my shots had broken a hind leg, the brute would most certainly have seized me. Even as it was, I had barely time

to swing myself up out of his reach before he arrived at the foot of the tree.

When the lion found he was too late, he started to limp back to the thicket; but by this time I had taken the carbine from Mahina, and the first shot I fired from it seemed to give him his quietus, for he fell over and lay motionless. Rather foolishly I at once scrambled down from the tree and walked up to him. To my surprise and no little alarm he jumped up and attempted another charge. This time, however, a Martini bullet in the chest and another in the head finished him; he dropped in his tracks not five yards away from me, and died gamely, biting savagely at a branch which had fallen to the ground.

By this time all the workmen in camp, attracted by the sound of the firing, had arrived on the scene, and so great was their resentment against the brute who had killed and devoured such numbers of their comrades that it was only with the greatest difficulty that I could restrain them from tearing the dead body to pieces. Eventually, amid the wild rejoicings of the natives and coolies, I had the lion carried to my *boma*, which was close at hand. On examination, we found no less than six bullet holes in the body, and embedded only a little way in the flesh of the back was the slug which I had fired into him from the scaffolding about ten days previously. As in the case of his companion, the skin was deeply scored all over by the thorns of the *bomas* through which he had to force his way in order to get at his victims.

The news of the death of the second "devil" soon spread far and wide over the country, and natives actually travelled from up and down the line to have a look at my trophies and at the "devil-killer", as they called me. Best of all, the coolies who had absconded came flocking back to Tsavo, and, much to my relief, work was resumed, the bridge was completed and we

were never again troubled by man-eaters. It was amusing, indeed, to notice the change which took place in the attitude of the workmen toward me after I had killed the two lions. Instead of wishing to murder me, as they once did, they now could not do enough for me, and, as a token of their gratitude, they presented me with a beautiful silver bowl, as well as with a long poem written in Hindustani describing all our trials and my ultimate victory.

J. H. PATTERSON.

Iver, Bucks, England.

September, 1925.



Map of Africa showing location of Tsavo.



THE FIRST MAN-EATER KILLED. (See p. 33.)



TREE FROM WHICH SECOND LION WAS SHOT. (See p. 37.)

MAMMALS OF THE CHICAGO AREA

BY

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ASSISTANT, DIVISION OF MAMMALS



ZOOLOGY
LEAFLET 8

FIELD MUSEUM OF NATURAL HISTORY
CHICAGO
1925

The Zoological Leaflets of Field Museum are devoted to brief, non-technical accounts of the history, classification, distribution and life habits of animals, with especial reference to subjects shown in the Museum's exhibits.

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D. C. DAVIES, DIRECTOR

FIELD MUSEUM OF NATURAL HISTORY
CHICAGO, U. S. A.



MAMMALS OF THE CHICAGO AREA.
PART OF AN EXHIBIT IN FIELD MUSEUM OF NATURAL HISTORY.

FIELD MUSEUM OF NATURAL HISTORY

DEPARTMENT OF ZOOLOGY

CHICAGO, 1925

LEAFLET

NUMBER 8

Mammals of the Chicago Area

The "Chicago Area" is, for convenience, regarded as covering all territory within fifty miles of the center of the city of Chicago. Therefore, it includes parts of three states, reaching just beyond the southern border of Wisconsin on the north and extending southward to the Dune Region and the whole southern end of Lake Michigan in Indiana. The pioneer student of mammals in this area was Robert Kennicott, whose list of the mammals of Cook County, Illinois, published in 1855, is still the most important paper devoted exclusively to the area. Since his time, scattered observations have been made, resulting in considerable additions to knowledge of the subject, but no thorough study has been carried out. The present paper is intended to summarize existing knowledge and to assist and stimulate local naturalists who may desire to pursue the subject.

The study of mammals is more difficult and not so easily entered into as the study of birds. Most mammals are nocturnal and the diurnal ones, in the majority of cases, are shy and elusive. The different forms to be met with in one region are very limited, about thirty-five in the Chicago Area as compared to two hundred and seventy birds occurring there. Many identifications depend largely upon dental or cranial characters and require time and work in preparing the skull for study and, in many cases, the use of a high powered lens on the smaller skulls, troubles not met in amateur bird study. For one outside a scientific insti-

tution, the life histories and photography of mammals might be the easiest and most interesting branches of the study. A large percentage of the work must be done with captive animals, but most animals are easily tamed and make interesting pets.

Of the fifty-three species of mammals formerly living in northern Illinois and Indiana, fourteen have entirely disappeared, ten are now very rare, and the rest are waging a losing battle with so-called civilization. Many of the larger ones disappeared from this section over a hundred years ago and, today, only a few scattered bones are left to show that elk, deer, buffalo and bear once occurred here. Wolves, cougars, lynx, foxes and other predatory animals were

soon driven out. These were quickly followed by the valuable fur-bearers, such as the beaver, marten, badger, and otter. While some fur-bearers of value are left in small numbers, the majority of mammals here now are small rodents of more harm than benefit to man. The two species that thrive best are the unwelcome foreigners, the House Rat and House Mouse. The next quarter century will undoubtedly see the ranks of the rabbit, muskrat, skunk, coon and mink greatly thinned, if not wiped out entirely. The thirty-nine species living here, today, represent six of the thirteen orders found in North America. These are the Rodentia (gnawers), Lagomorpha (rabbits), Carnivora (flesh-eaters), Insectivora (shrews and moles), Chiroptera (bats), and Marsupialia (opossums). These in turn are divided into superfamilies, families, subfamilies, genera, subgenera, species and subspecies.



The status of our mammal fauna, at present, is indicated by the following lists:

Mammals now Living in the Area.

1. Woodchuck.....*Marmota monax*
2. Striped Gopher.....*Citellus tridecemlineatus*
3. Gray Gopher.....*Citellus franklini*
4. Gray Chipmunk.....*Tamias striatus griseus*
5. Red Squirrel.....*Sciurus hudsonicus loquax*
6. Gray Squirrel.....*Sciurus carolinensis leucotis*
7. Fox Squirrel.....*Sciurus niger rufiventer*
8. Flying Squirrel.....*Glaucomys volans*
9. Northern White-footed Mouse.....*Peromyscus leucopus borealis*
10. Prairie White-footed Mouse.*Peromyscus maniculatus bairdi*
11. Common Meadow Mouse.....*Microtus pennsylvanicus*
12. Prairie Meadow Mouse.....*Microtus ochrogaster*
13. Pine Mouse.....*Pitymys pinetorum scalopsoides*
14. Muskrat.....*Ondatra zibethica*
15. House Rat.....*Rattus norvegicus*
16. House Mouse.....*Mus musculus*
17. Hudson Bay Jumping Mouse.*Zapus hudsonius*
18. Mearns's Cotton-tail Rabbit.*Sylvilagus floridanus mearnsi*
19. Raccoon.....*Procyon lotor*
20. Bonaparte's Weasel.....*Mustela cicognanii*
21. New York Weasel.....*Mustela noveboracensis*
22. Least Weasel.....*Mustela allegheniensis*
23. Mink.....*Mustela vison mink*
24. Skunk.....*Mephitis hudsonica*
25. Coyote.....*Canis latrans*
26. Red Fox.....*Vulpes fulva*
27. Prairie Mole.....*Scalopus aquaticus macrurus*
28. Star-nosed Mole.....*Condylura cristata*
29. Long-tailed Shrew.....*Sorex cinereus*
30. Short-tailed Shrew.....*Blarina brevicauda*
31. Small Short-tailed Shrew....*Cryptotis parva*
32. Little Brown Bat.....*Myotis lucifugus*
33. Say's Bat.....*Myotis subulatus*
34. Silver-haired Bat.....*Lasionycteris noctivagans*
35. Brown Bat.....*Eptesicus fuscus*
36. Red Bat.....*Nycterus borealis*
37. Hoary Bat.....*Nycterus cinerea*
38. Rafinesque's Bat.....*Nycticeius humeralis*
39. Virginia Opossum.....*Didelphis virginiana*

Mammals Extirpated within Historic Times.

1. Virginia Deer.....*Odocoileus virginianus*
2. American Elk.....*Cervus canadensis*

3. American Bison.....*Bison bison*
4. Beaver.....*Castor canadensis*
5. Eastern Cougar.....*Felis couguar*
6. Canada Lynx.....*Lynx canadensis*
7. Bobcat.....*Lynx rufus*
8. Gray Fox.....*Urocyon cinereoargenteus*
9. Timber Wolf.....*Canis nubilus*
10. Otter.....*Lutra canadensis*
11. American Badger.....*Taxidea taxus*
12. Marten.....*Mustela americana*
13. Fisher.....*Mustela pennanti*
14. Black Bear.....*Ursus americanus*

The order of rodents (*Rodentia*) is well represented and includes the woodchucks, squirrels, rats and mice, all gnawers. Members of this order have two upper and two lower incisors with a large gap between them and the cheek teeth. They are, for the most part, vegetable feeders, meat forming a very small percentage of their diet, and are all harmful to agriculture. Among them are found subterranean, terrestrial, aquatic and arboreal mammals.

The Flying Squirrel is more common in this area than is commonly supposed, as it is nocturnal and rarely ventures forth by day except occasionally in very cloudy weather. It lives in old woodpecker holes and often under the eaves or in the attics of houses. It is very sociable and sometimes as many as twenty will live peaceably together in one large hollow. The strong, furred membrane on each side, between the front and hind legs, enables it to glide or sail from the top of one tree to the foot of another which it then ascends and sails to the next one. The food of this squirrel, much like that of other squirrels, consists of nuts, seeds, insects and, sometimes, eggs and even young birds. From four to





MAMMALS OF THE CHICAGO AREA.
PART OF AN EXHIBIT IN FIELD MUSEUM OF NATURAL HISTORY.

six young are brought forth in April and are said to make very tame and docile pets.

Of the three true squirrels found here, the Northern Gray is perhaps the most common, having taken man into his confidence more than his cousins, the Red and the Fox Squirrels. **Gray Squirrels** are common in the parks and suburbs about Chicago and, as they have not been molested, have become very tame. In the woods, however, especially during the hunting season, they are quite shy and can dodge around a tree and disappear in a most surprising manner. They live chiefly upon nuts and seeds of trees, but occasionally eat small fruits and beetles and their larvae. In the spring they damage maple trees by girdling the branches and drinking the sap. Birds' nests also suffer from them. In the woods, they either live in hollow trees or build a large nest of branches, leaves and bark or, with the same material, roof over an old crow's nest. In the suburbs, they often get under the eaves of houses and into the walls, where they become a great nuisance, especially early in the morning, as they are very noisy. There are generally two litters a year, one in April and one in September, of from two to five young.

The **Fox Squirrel** is not so common as the Gray, and is found farther away from towns. This squirrel does not live in colonies. Each pair prefers its own particular wood, and keeps all others out. Hollow trees are their homes, although they do build nests of sticks and leaves for summer use. Like the Gray Squirrel, they do not store food in any one place but bury nuts and acorns singly for winter use. Even under deep snow, they find at least a certain part of the nuts previously buried. Two litters of from two to four young are born each year and, when they are old enough, they are driven out to fare for themselves.

The **Red Squirrels** are smaller than the other squirrels that occur here, and are most common in the Dune Region. Like other tree squirrels, they live mainly in woodpecker holes and hollow trees, but they have occasionally been noticed occupying holes in the ground. They lay up large winter supplies of nuts, seeds and corn when it can be found, for while they do not mind the coldest weather, they prefer to stay in on cloudy and stormy days. They are particularly fond of pine seeds, which accounts for their abundance in the Dunes. During the summer, all the wild fruits of the woods are on their menu, to which they add insects, mushrooms, young birds and eggs. The young, born in April, number four to five and, sometimes, even six.

A member of the squirrel family that lives mainly on the ground and about stone walls and brush heaps, is the **Gray Striped Chipmunk**. Being about ten inches

long, of a gray brown color, with two or three stripes on the back, and a slightly bushy tail, it is easily recognized as it darts under a brush pile or



into its hole, uttering a sharp series of whistled alarm notes. It is only seen from April to the last of October, for during the winter it hibernates in its burrow several feet under ground. In the summer, it is kept busy collecting a supply of nuts, seeds and grain for meals when it wakes on warm days during the winter. Its burrow runs down a foot or two from the opening and then along and upward to the nest chamber, with perhaps a

storehouse or two along the way. There is a back entrance but it is always several rods from the other. The dirt is taken out in the cheek pouches and is deposited at a considerable distance from the entrances, all possible care being taken to conceal them. These entrances are just large enough to admit the animal, but the burrow becomes larger inside. Besides the stores collected for winter use, the Chipmunk eats meat, when it can be found, in the form of young birds, mice or snakes. It damages truck gardens, eating all kinds of berries and the tendrils of such things as peas, beans and cucumbers. In spite of all its faults, it is a cheery, active, little creature to have about, and, like the squirrels, it is easily tamed.

Another ground living species that hibernates during the winter, is the **Striped Gopher**. It prefers the more open country, while the Chipmunk prefers the



more wooded areas. Appearing about the first of April, it may be seen until late in October when it turns in for its long winter sleep. Gophers are larger and heavier animals than Chipmunks and the ears are smaller and the tails not so bushy. They have six buffy-white stripes on the back, between which are brown stripes with pale dots. Their burrows are much alike, a long tunnel with store-rooms and a living room or nest. They pass the winter and bring forth the young in these burrows. The young arrive in May

or June and average six to seven, although ten have been found. It is almost three weeks before any hair appears on them, and they stay with the female until late in the summer. Under such circumstances it is only possible to raise one litter a year. Before the young are born, and during the time they are with the mother, the male leaves home and shifts for himself as best he can, digging a summer home. Their food consists partly of beetles, grasshoppers, caterpillars and weed seeds, but, unfortunately, they have a fondness for grain and do a great deal of damage to crops. They dig up the seed as soon as it is planted, eat the young shoots and, later, the ripened grain. Working during the day, they are ever on the alert, sitting up to look about for danger and, in doing so, seem to stretch themselves to almost twice their natural length.

A western species, whose range just reaches this area, is the **Franklin's Ground Squirrel or Gray Gopher**. It is chiefly grayish in color, the top of the head being

blackish and
the tail gray.
This gopher
is by no
means com-
mon and is
only locally
distributed.



Restless and wandering, it appears unexpectedly in a locality where it may stay all summer or only for a few weeks. Its burrows are deeper, and it appears a little later in the spring than the preceding species, but its other habits are practically the same. Both these gophers cause no little damage to golf courses when they decide to dig their burrows in a fairway or putting-green. It often takes several weeks before they can be discouraged or all caught in traps.

Each year one of our mammals receives much publicity of a doubtful character. This is the **Woodchuck** or **Groundhog** that is supposed to waken the second of each February and come out for a look at the weather at noon. It is doubtful if the Woodchuck realizes the great responsibility placed upon it. However, after its

long winter sleep it does come out of its hole late in March when it is much warmer. Its burrows in this region are in some small clump of woods or ravine, easily accessible to a pasture or farmer's garden. During the summer, early in the morning and late in the afternoon, it comes out to feed on the clover and alfalfa or on almost any of the vegetables of the garden. The Woodchuck does not store food for winter, so he must put on a good layer of fat before the first of October or whenever the first heavy frosts come. The four to six young are born early in May, but do not get their first look at the world for some four or five weeks later. When old enough to care for themselves, they leave the home burrow and find another home in some other locality. The Woodchuck seems to be a heavy, lazy animal, but, when cornered, can put up a surprisingly good fight.



Although the **House Mouse** and the **House or Norway Rat** have been in America since the time of the first settlers, they have never made good citizens. The House Mouse came originally from southern Asia, and the Rat from Europe, but long ago they attached themselves to man and have accompanied him on all his travels, until, today, they are found in all parts of the

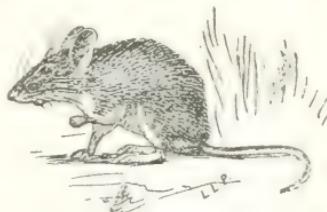
world, not only in the cities where they are in greatest numbers, but also in many out-of-the-way places far removed from civilization. They are more prolific than wild mice and reach maturity at an earlier age. The House Mouse raises about five litters a year of from five to nine young, and the House Rat four to six litters of from six to twenty young. Both are very destructive in their search for food, and the House Rat is known to carry fleas that are infected with Bubonic Plague germs. One cannot be too careful in ridding the house of the first ones that appear, for, like the House Fly, two mean a small army in a very short time. Guillotine traps and also cage traps, when covered or hidden, are two of the best traps for catching them. Rats, like other vermin, increase under unsanitary conditions, and the more food they get, the oftener they breed and the more young they have in each litter. Therefore, food should be kept where they cannot reach it and all garbage kept in metal containers. The liberal use of cement for foundations and floors and strong wire netting over basement windows and the ends of drain pipes, is a great help in keeping them out.

Two forms of White-footed Mice are very common here, one inhabiting the woods, known as the Northern White-footed Mouse, and the other, the Prairie White-footed Mouse, living in the open fields as its name implies. The woodland form is light brownish in color with pure white underparts, while the prairie one is of a darker color and is smaller with a somewhat shorter tail. Both have large ears and big black shoe-button eyes.

The **Northern White-footed Mouse** makes its home in hollows of trees or roofs over a bird's nest and lines it with grass. It will even dispossess birds of an occupied nest and sometimes eat the eggs or young. The diet of these mice is mainly vegetarian, consisting of

nuts, fruit and bark. In the fall, they commonly resort to grain fields. They also like meat when it can be found. One that I caught in a trap was half eaten by its fellows. They store up grain and nuts for the winter in hollows or bury them in holes and stumps under logs where they sometimes make their nests. Once my dog brought me a tin can in which a mouse of this species had four half grown young of a slaty gray color. Another time, in a cabin in the woods, I found that a female had made a nest of cotton in my shooting coat pocket and had five newly born young there. The young number from three to six and two or three litters are born each season. In winter, as many as a dozen live together, separating in the spring to make their nests and rear their young.

The Prairie White-footed Mouse, living away from trees, must of a necessity make its home under ground; here it winters and the first litter is born. As the weather becomes warmer, and the long grass affords protection, it lives more above ground under old logs, stones or fences. In the fields it lives on insects, leaves of certain plants and weed seeds. During the fall it is found in the shocks of corn and other grain and in the winter it often causes great damage by burrowing under young fruit trees and eating the bark from the roots. The average number of young is five, and they have been found during every month from March to November. Like its woodland cousin, it stores up quantities of food for winter, but it lives in pairs only in the winter burrows.



Two forms of meadow mice or voles also occur here, the Common Meadow Mouse and the Prairie

Meadow Mouse. They are of a stockier build than the White-footed Mice and have shorter ears and tails. The **Common Meadow Mouse** lives in marshes, damp pastures and boggy woods. It is a dark grayish animal, lighter on the sides and lighter gray underneath. Living in such wet places, it is naturally forced to live above ground most of the time and to make its nests in tussocks of grass or in very shallow burrows above the damp ground. The young number five or

six and, sometimes, eight, and three litters are born each season. Meadow mice are active throughout the year. In winter they live under the snow in nests of grass which are also used as

store houses and are filled with grass and weed roots, grain and bark. Even living as they do, under the grass in summer and under a blanket of snow in winter, many cannot escape the sharp eyes of hawks and owls that continually prey upon them. Those living near a stream or pond are as much at home in the water as on land, and often use it as a means of escape when pursued.



The Prairie Meadow Mouse or Prairie Vole has many of the same habits and tastes as the preceding species, but, since it prefers high and dry ground, its manner of living is naturally not the same. It is of a slightly lighter color with a more grizzled appearance, and the underparts are more buffy than gray. Inhabiting dry fields, it is able to burrow and live under ground during the winter, bringing forth its first litter of young there. The burrows contain store-rooms with provisions for winter, such as small bulbs and grass roots. Grain also forms a large part of its diet. When it encounters roots of fruit trees in its burrowing, it eats the bark and often kills the tree.

A mouse closely related to the Meadow Mouse is the **Pine Mouse** or **Mole Mouse**, but it is very rare in this region, only four having been recorded. It is smaller than either of the meadow mice and, although it has the same general form, it has softer and silkier fur. The habit of making many burrows under the ground where it lives most of the time, has earned it the name of Mole Mouse.

The largest member of the rat and mouse family is the **Muskrat**, one of our important fur-bearers. In spite of the war waged against it, it still makes its home close to man and his works. Muskrats are fairly common about Chicago. They were especially numerous, a few years ago, in the lagoons of Jackson Park. Man is really its only enemy, since he has driven out the Otter and greatly thinned the ranks of the Mink. It lives chiefly in burrows in or under banks, the entrance being under water and the passage slanting up to a large chamber above the level of the water. It also builds large houses of reeds and weed stalks with an entrance under water. The food consists of fresh-water mussels and aquatic plants. It does a good deal of damage to water-lilies in parks. One reason, perhaps, why the muskrat is able to live on among men is that, during the winter when the ponds are frozen, it can move about freely under the ice in search of food and yet cannot be seen. When there is space between the water and the ice, it can breathe there, and can always get air near the thin ice along the shore. One litter of from five to seven young is raised each year. The flesh of the muskrat is said to be very palatable either boiled or roasted.

One of our most interesting but, unfortunately, most uncommon mice, is the **Jumping Mouse**. It is a little tawny-colored animal with medium-sized ears and very long hind feet and a four and a half inch tail

which is fully an inch longer than its body. It is said to be able, when frightened, to make jumps of ten feet in its effort to escape. In the summer, it is apt to be met with in this area, mainly in cool places either in the woods or fields. It spends the cold months asleep,



rolled into a tight little ball in its nest under ground. Nests of grass and leaves are also constructed on the ground for summer use, where the three to six young are sometimes born.

Rabbits, although formerly in the order Rodentia, have now been separated and placed in the order Lagomorpha. The members of this order are closely related to the Rodentia, but among other differences, have four upper incisors instead of two. The second pair is very small and is placed behind the front ones. Our representative is the **Cotton-tail Rabbit** which is so common in all the Chicago suburbs. It does a good deal of damage to suburban gardens in summer and to trees and bushes in winter. It seems to be more common about small towns than in the open country where hunting is permitted. It lives in small, wooded areas and brushy fields, feeding on grass, leaves and buds in the summer and mainly on bark in the winter. Piles of brush cut in the fall often have all the bark stripped from the small branches and twigs by spring. Three

litters are raised each season, the first one coming very early in the spring. I once found five young rabbits in their cup-shaped hollow under a brush pile early in March while snow still covered the ground. The young stay with the mother only about a month, when they start out for themselves, and are often found in the woods and fields. I remember a large mastiff that used to bring them to us in his mouth, alive and unharmed. Rabbits rely on staying quiet to escape notice and will not move until literally stepped on; then they race off with great bounds, their little powder-puffs of tails bobbing up and down as they go. The larger mammals, birds of prey, and man, all hunt the rabbit and, were it not so prolific, it would soon be exterminated.

The order Carnivora comprises the flesh-eating mammals, mainly beasts of prey, as the dogs, cats, weasels and coons. The larger ones, such as the wolves, bears and cats, are soon driven out of a settled district. The largest mammal of this region is still with us only because it has developed a cunning and shrewdness rarely equalled among other mammals. This is the **Red Fox** which, while seen occasionally in other localities, is practically confined here to the Dune Region of northern Indiana. The fox, like the muskrat, has benefited by man's driving out its enemies, and, as it can nearly always outwit man, it is fairly safe. If, however, a fox raids too many chicken coops, there is sure to be a hunt organized and the thief will be hunted down and destroyed. If it confines itself to such food as mice, grasshoppers, muskrats, rabbits, and to wild grapes and other fruits, its presence is seldom suspected. The fox makes its den in holes in



the ground, some natural cavity in the rocks or in hollow stumps. One litter of four to eight young is born each year in April.

One other large mammal, the **Coyote** or **Prairie Wolf**, is occasionally reported in this region. It is probable that some of these reports are based on pure-bred, fully wild coyotes, but actual specimens with skulls are usually needed to prove whether or not they refer to wild or half wild dogs or animals escaped from captivity. The body of one killed near Waukegan, in December, 1924, showed very plainly how it is received in a settled area, for it contained all sizes of shot, some which it must have carried for nearly three years. While the skin was large, it appeared to be almost pure coyote, but the skull showed that it was not pure-blooded, but probably had a strain of domestic dog in its ancestry. Coyotes are especially destructive to sheep and, in some parts of the west, sheep-raising is seriously handicapped by them. They have a cunning equal to or perhaps greater than that of the fox and are well able to hold their own when the odds are not too strong against them. So a constant warfare must be kept up to keep their numbers below the danger point.

The **Skunk** is a very attractive looking animal, but it is another case of fine feathers not making fine birds, for when molested or angry, it ejects a strong, nauseating fluid which makes the vicinity for at least a quarter of a mile about most untenable. The skunk's motto is, however, "Let me alone and I'll let you alone," so if not molested, it goes quietly on its way in search of bugs and beetles. Its menu varies from chickens' eggs, young mice, birds



and snakes in the early spring and summer, to beetles and grasshoppers in the fall. When food becomes scarce in the fall, skunks hole up until the warm days of February. They also live under barns, sheds, and old farm buildings. The young are born early in May and number from four to six. The scent glands can be removed from the animal, making it harmless, and this is generally done on fur farms, so the fur will not have the disagreeable odor on damp days. The odor is noticeable for a number of years in the hair of dogs that have killed skunks, especially when the dogs are wet. Some Horned Owls have a strong odor of skunk, as they often kill them for food. People who have eaten the flesh of this animal claim that it has a very fine flavor and that it reminds one of chicken. The ranges of the Northern Skunk and the Illinois Skunk meet in this area, so it is hard to say to which sub-species our skunks belong. Most of them are intergrades between the two and could be referred to either. In the Dune Region, it also intergrades with the Eastern Skunk.

A valuable fur-bearer still occasionally met, is the **Mink**. It might be termed a water weasel, for it is generally found near the water and part of its food consists of fish, frogs, crayfish and other aquatic animals including the muskrat. Although it prefers the water, it is as much at home on land. Its swiftness even enables it to catch squirrels and rabbits. It also eats many meadow mice and farmers' chickens or other poultry when it can get them. Young birds and eggs are destroyed and, in fact, anything in the shape of meat, since it never eats any vegetable matter. It lives singly and is seldom found in pairs except during the mating season. The



young are born in April or May in a burrow or hollow under an old log, and stay with the female until nearly grown, when they gradually wander away and find new homes for themselves. The mink is of dark brown color with a patch of white on the chest and, unlike its relatives, the weasels, it does not turn white in winter.

Only one weasel is known to occur here in any numbers, and it is only locally common. This is the **New York Weasel**, which is a long, slim animal, vary-



ing from twelve to sixteen inches in length. The female is much smaller than the male. In summer, it is dark

brown with white underparts, and in winter, the whole animal turns white. The white is often tinged with yellow. The end of the tail is black in both winter and summer pelages. Bonaparte's and Least Weasels have been taken in southern Wisconsin and, therefore, are likely to be found here. They are smaller, and the Least Weasel lacks the black tip on the tail. All the weasels are ferocious and blood-thirsty little animals, many times killing for the pure joy of it even when not prompted by the pangs of hunger. At such times they only suck the blood and eat the brains of their victims. Farmers have lost as many as fifteen or twenty fowls in a single night in this manner. These cases are the exception, however, for meadow mice, wood mice, ground squirrels, rabbits and other small mammals are their usual food, and in this way they are a great benefit to the farmers. Like the mink, they live singly except in the breeding season, and the young stay with the mother until late in the fall. These number from five to eight.

In the more wooded districts, especially in the river bottoms, the **Raccoon** is sure to be found. Its home in this region is generally in some hollow tree, although I have known it to live under barns. The coon usually wanders about at night, either up in the trees hunting birds' or squirrels'



nests, or along the shores of creeks and streams, looking for frogs, crayfish and other aquatic animals. Green corn is one of its favorite foods and it is apt to do much damage, tearing down much more than it can eat. When it gets into a hen roost, it also kills more than it needs and returns the next day for more, which is very often its undoing. A coon makes an intelligent and interesting pet. It has a curious habit of washing all meat before eating it, and captive coons have been known to refuse to eat when no pan of water was provided for them. The young number from three to six, and are born in April and May and stay with the parents for some time. When cold weather comes on, the whole family rolls up in the nest and takes cat-naps all winter, appearing now and then on warm days.

The order Insectivora includes the shrews and moles which, like the Carnivora, live on animal food, but in the shape of insects and worms. Our smallest mammal is the **Common or Long-tailed Shrew**, its body being only two and a half inches long and its tail an inch and a half long. It makes its home under old logs, tree roots and bunches of grass, in the woods and fields,

mainly in cool places. It is a very active little animal, moving so rapidly the eye can scarcely follow it among the brown leaves which it closely resembles in color. It is like the weasel in its ferocity and bloodthirstiness. Dr. C. H. Merriam tells of three he placed together in a large tumbler. One was at once killed and devoured, and eight hours later, one of the others had been eaten, and the remaining one with two of his kind and size inside him, was greatly extended by his day's meal. But little is known of its home life and young.

Besides this little fellow, a larger shrew is found here, the **Short-tailed or Mole Shrew**. This shrew lives in burrows and is continually making new ones in all directions in its hunt for insects, ground beetles and their larvae. Combined with this mole-like habit, its very small eyes and hardly noticeable ears under the fur have helped to give it the name of Mole Shrew. It is just as ferocious as its smaller cousin, but, being almost twice its size, can prey upon young mice and birds, and has been known to kill mice larger and heavier than itself. All shrews have glands

that permit them to emit a very strong, musky odor, and for that reason, although they may be killed, they are eaten by but few animals, owls and weasels being the only ones to which they are welcome. Shrews do



not hibernate but are active all winter. The **Small Short-tailed Shrew**, which is about an inch and a half shorter than the preceding species, has been recorded from this area but once. Dr. M. W. Lyon, Jr., took a single specimen near Tremont, Indiana, in the fall of 1924. The known range of this shrew just reaches our southern limits, but after more work has been done here, it will no doubt be found to include most of this region.



MAMMALS OF THE CHICAGO AREA.

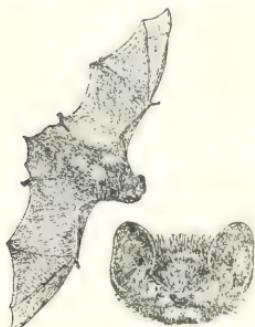
PART OF AN EXHIBIT IN FIELD MUSEUM OF NATURAL HISTORY.

Two Moles have been recorded from this region, the Prairie and the Star-nosed Mole, but the latter is very rare here. The **Prairie Mole** is a stocky animal about six inches long with enormous fore-feet which at once identify it. It lives under ground most of its life, forming many yards of tunnels in its search for the slugs, worms and larvae on which it feeds. When in captivity, it will eat meat. During the winter it digs deeper into the earth beyond the frozen ground for its food. The ground is raised in a ridge when the tunnels are made close to the surface and these give the trapper the clue as to areas inhabited by moles. The skin of the eastern moles, while equaling that of the European mole, is not so large or fine as that of those found on the Pacific Coast. At all times, the runways of the moles are used by other mammals, such as meadow-mice, pine mice and shrews, and the moles are unjustly blamed for the damage they do to plants and trees. The nest is a large mass of leaves and grass from six to eighteen inches below the ground. The mole produces two litters a year of from two to four young each.



The **Star-nosed Mole** is about the same size as the preceding species, but the feet are not nearly so large. It has numerous fleshy projections on the end of the snout that are used as feelers and from which it gets its name. This mole lives near the water and in damp boggy marshes and woods. But few of its nests have been found, and they were situated like those of the Prairie Mole, nearly a foot under ground. The Star-nosed Mole is active throughout the year and appears above ground more than any other species, even in winter. The Chicago area is on the edge of its range, which is to the north and east, so it is quite rare here.

But one family, the Vespertilionidae, is represented here from the order of Bats or Chiroptera. Seven species of this family have been recorded from this area.



Five of them, the Brown, Little Brown, Red, Hoary and Silver-haired are common, and there is one record each for Say's and Rafinesque's bats. They are purely insectivorous, hunting from sunset till dark and in the early hours of dawn. They live in caves, hollow trees, attics and crannies of old houses and in any

holes where it is dark and they can sleep during the day. Some of them migrate in the fall and others remain to hibernate. Like birds, they follow the water courses in their migrations and during the fall many are picked up in and about the Museum building. The young, numbering from two to four, go with the mother on her hunting trips, clinging to her breast when small. When too large for this, they are left in some hidden place to be called for later. They are among our most useful animals and deserve all the encouragement and protection possible.



The **Virginia Opossum** is the only representative of the Order Marsupiala found in this area. Like most of the other members of this order, the female carries

the young in a pouch for a number of weeks after they are born. Here they feed and grow until ready to come out and travel with their mother. Opossums have prehensile tails and their feet are like hands, so they can climb about in trees with nearly the ease of a monkey. They are practically omnivorous in their diet. They have been recorded in this region during the past fifteen years only from the Dunes where they are occasionally seen.

COLIN C. SANBORN,
Assistant, Division of Mammals.

In the alcoves just west of Pullman Hall are four groups of Chicago mammals. Seven species are shown with their natural surroundings. One shows the Muskrat and its house built in the water; one, the Woodchuck with young ones, enjoying a few moments outside the entrance to its burrow; one, the Red Squirrel, hunting about in the leaves; and one, the Short-tailed Shrew, Meadow Mouse, Northern White-footed Mouse, and Jumping Mouse, in their natural habitats, of wood, field and marsh. There is also a temporary screen in Stanley Field Hall, showing nearly all the Chicago mammals.



PIKE
PICKEREL
AND
MUSKALONGE

by
ALFRED C WEED
Assistant Curator of Fishes

ZOOLOGY LEAFLET
9



FIELD MUSEUM OF
NATURAL HISTORY
Chicago
1927

The Zoological Leaflets of Field Museum are devoted to brief, non-technical accounts of the history, classification, distribution and life habits of animals, with especial reference to subjects shown in the Museum's exhibits.

LIST OF ZOOLOGICAL LEAFLETS ISSUED TO DATE

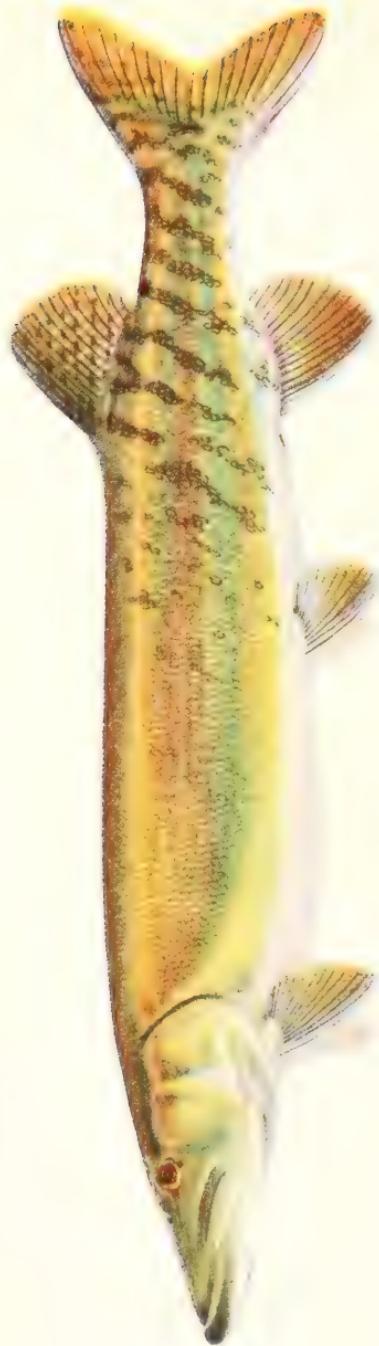
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D. C. DAVIES, DIRECTOR

FIELD MUSEUM OF NATURAL HISTORY
CHICAGO, U. S. A.

LEAFLET 9.

PLATE 1.



NORTHERN MUSKALONGE.
Pisces immaculatus Garrard.

FIELD MUSEUM OF NATURAL HISTORY

DEPARTMENT OF ZOOLOGY

CHICAGO, 1927

LEAFLET

NUMBER 9

Pike, Pickerel and Muskalonge

Freshwater anglers have many general points of discussion, not the least of which is the question of the proper names of Pike, Pickerel and Muskalonge. There are few questions carrying more possibilities of argument, difference of opinion and general misunderstanding than this. The fish concerned are mostly of large size and have high qualities both as food and game. They belong in two groups, the true Pikes, genus *Esox* of the pike family, Esocidae; and the so-called Walleyed Pike and the Saugers, which belong to the perch family, Percidae.

The trouble would be quite serious enough if we were only concerned with members of the true pike family, of which there are six species in North America. These, using the names considered preferable, are the Chain Pickerel, Trout Pickerel, Pickerel, Northern Muskalonge, St. Lawrence Muskalonge and Chautauqua Muskalonge. Unfortunately many of the same names have been applied to the walleyes and saugers which are members of the perch family. These are very different in essential points of structure although similar in habits and general appearance. The extent of the difficulty may be imagined from the fact that there are as many as eighty names for one fish and seven fish for one name.

In the present paper an attempt is made to solve the difficulty by giving descriptions and pictures of all

the fishes involved, together with a list of names which have been or are applied to each. The list is, of course, not complete. New names are all the time being brought to the author's attention, but it is hoped that it is complete enough so that two fishermen may talk together without having to spend too much time arguing about the names of the fish they are discussing.

The colored plates are the work of Mr. Leon L. Pray, Fish Taxidermist of Field Museum, and with three exceptions are from his own studies from life. The plate of the St. Lawrence Muskalonge (Plate 3) is adapted from a colored plate prepared by S. A. Kilbourne and published by Charles Scribner's Sons in 1879. The Trout Pickerel (Plate 7, lower figure) is adapted from a specimen mounted by Francis West. The outline of the Chain Pickerel (Plate 5) is from a photograph and the coloring adapted from a colored plate by Mr. Louis Rhead.

A large part of the value of this work is due to the assistance of Mr. George P. Engelhardt, Mr. Louis Rhead, the New York State Conservation Commission and the Wisconsin Conservation Commission in furnishing many of the specimens used in preparing both the text and the colored plates.

COLOR OF THE PIKES

Few persons have a clear idea of the color of fishes. In our ordinary associations we see few things that have the power of changing color or color pattern at will. The Bobolink is a beautiful black and white bird as he sings over the meadows in early summer. A few weeks later he changes to the streaked brown color of his mate for the journey south. The Snow Bunting when it comes to us in early winter has various shades of buff and tan. When it goes north in early spring it is plain black and white, with no buffy markings at all. There are few

birds or mammals which can produce more complete or sudden changes than these. Lizards have more power over their color and some of the changes have been widely advertised. The power of the Chameleon in this respect has even formed the basis of one of *Æsop's* fables. In New Orleans as the sun comes out after a sudden shower we may see a bright green lizard crawl off a banana leaf onto a fence. In a few seconds it has changed to the exact color of the wet wood. A little later, when the wood has dried to a silvery gray we may find the lizard still there and still the exact color of the board on which it is sunning itself.

It is not at all well known that many, if not most, fishes have greater power over not only their color but even their color pattern than the Chameleon. This is especially true of the fishes that live in rather shallow water and hide among rocks, logs or other objects. Those that live about mud banks or in muddy water do not need this power and usually do not have it. A fish which is showing all its most brilliant colors for the purpose of attracting attention may suddenly meet another a trifle larger and stronger. The smaller one will turn pale even while it is starting to escape.

Few fish have greater power of changing color and color pattern with every passing mood or every change in surroundings than the pikes and pickerels. Moving from the shelter of a mass of bright green *Myriophyllum* to a mass of *Potamogeton* with the stems and under sides of the leaves red or brown, one of these fishes will change from a pattern of bright green and greenish silver with plain fins to a pattern of browns with red fins. Under the *Myriophyllum* the markings may be very fine, the light and dark streaks less than the width of a scale. Moving to the shelter of a willow bush on the bank, the dark and light bands

may change so that the fish will be almost as coarsely barred as a Yellow Perch.

There are a few basic patterns which are fairly constant, but the variations are without number. All young pikes and the adults of several species have a rather regular cross barring as is shown on Plates 1, 2 and 7. This pattern is hardly ever as simple as is shown in the lower figure of Plate 7. That pattern is almost unknown except in the New England region, where the fish commonly live under the shade of bushes which fringe the banks of small streams. Young specimens often have a similar pattern, with the cross bars divided by a horizontal light stripe along the middle of each side. A further variation might be to move one set of blotches a short distance so as to produce a checker-board pattern.

The blotches in the straight or the checkered pattern may split vertically and produce a zigzag pattern or a pattern of much narrower cross bars. In very young specimens, the pattern of the lower figure on Plate 7 may be still farther reduced so as to form blotches, almost square, on the sides. This latter pattern is seldom seen in fish more than three to four inches long. A Trout Pickerel, about eight inches long, from Gainesville, Florida, has as well marked a reticulate pattern as is shown for the hybrid pickerel on Plate 6. Another, about eleven inches long, has varied in another direction. The narrow cross stripes shown on the middle figure of Plate 7 are divided again vertically and then spread out until all that is left is a series of fine diagonal lines, parallel with the edges of the scales, forming a network of which each mesh encloses two or four scales. It should be remembered that all the patterns shown on Plate 7 can be produced at will by any of those fish. The one at the bottom is not often produced in just that form except by the Trout

Pickerel but the individual carrying that pattern could have changed in a fraction of a second to either of the other patterns shown. It could have changed also to a pattern of bright greens or to a combination of dark and silvery greens.

Color changes among the members of this group are quite as startling as the changes of pattern although they are, perhaps, not quite so common. Any of the fish shown on Plate 7 could assume the color of any of the others at will. However, the *usual* color of any of these fish is, probably, more constant than the color pattern. The fish adapts its color to its surroundings and sticks pretty closely to one locality. A Pickerel may be found in one place day after day for weeks at a time. It is very exact in its placing, always headed the same way and always the same distance from a certain stick or tuft of weeds. Thus its eye is in position to watch through the same water lanes.

The color of any of this group may vary from almost plain silvery to a moss green so dark as to be practically black, with all the greens and yellows and some of the reds in between. In all cases, the color and color pattern are so arranged that they give the fish a close resemblance to some natural object nearby. It is usually a stick or log that the fish resembles and the arrangement of light and dark will look like spots of sunlight and shade. The Pickerel lies in wait in rather open places and his spots look like the little specks of sunlight shining on the bottom through the ripples at the surface. The Grass Pickerel hides in the shade of the water plants and his cross bars are like the shadows of the long, narrow leaves. When the Northern Muskalonge lurks in an old tree top his cross bars are like the shadows of the dead limbs.

The Trout Pickerel usually lives in water stained brown with the leaves of the forest and swamp trees

and plants. Also most of the water plants have brownish leaves or stems or both. It arranges its color accordingly. The color of the lower figure of Plate 7 would indicate that the fish was taken in a swampy stream or pond where the water was quite brownish and that the fish usually stayed in the shelter of a tree top or of bushes that hung over the bank. If the same fish had been in the habit of watching for food from the shelter of a mass of bright green water plants with fine leaves, it would have shown about the same color and pattern as the middle figure of Plate 7, or even with finer markings and a brighter green color. The finer markings of the Grass Pickerel show that it is more a creature of the open bay than of the bushy stream. There is no real point of difference by which we can separate the Trout Pickerel of New England from the Grass Pickerel of Lake Ontario. They are found all the way from Maine to Florida, across the Gulf coast to Texas, up the Mississippi to southern Wisconsin and down the Great Lakes to the St. Lawrence. There is a rather regular variation all the way around but no dividing point between one and the other. They can probably be divided into several geographic races or varieties which are well marked enough to receive separate names. The form in the Great Lakes seems to be different from the one in the Ohio River. The one in New England is different from the one in the Chesapeake Bay region. The Florida group is different from either and there will probably be other groups that can be recognized. The differences between any one group and its near neighbors are very slight and can be seen only in the average of a large number of specimens, but the differences between the two ends of the series are very well marked as is seen in the two lower figures of Plate 7. The middle figure of that plate represents a common pattern



CHAUTAUQUA MUSKALONGE.
Pisces *ohionensis* Kirtland.

as seen in Sodus Bay, New York, one of the largest bays along the south shore of Lake Ontario, while the lower figure represents a common pattern on Long Island and northeastward.

The group of Muskalonge seems to have pretty nearly the primitive color and color pattern of the pikes. In the Chautauqua Muskalone, Plate 2, the pattern of the adult fish is practically the same as in the Trout Pickerel or the Grass Pickerel. The main difference is that the markings are larger in actual size, if not proportionately, because the fish is so much larger. There is the added difference, that, in the smaller species, very large adults show a great tendency for the dark streaks to break up into a very intricate and irregular pattern, which gave one scientific name to part of the group from their resemblance to worm tracks. The Northern Muskalone (Plate 1) carries the same pattern but shows a decided tendency for it to break up into roundish or elliptical spots. This fish also shows a very strong tendency to lose all color markings and become simply a green, golden or silvery bronze, usually with some traces of cross barring on the tail. The St. Lawrence Muskalone (Plate 3) has carried this tendency a step farther and has reduced the color pattern to a series of roundish or elliptical spots. The color of the three is also different. The Northern Muskalone lives in water which is often stained almost as red as the liquor of the tan vats. So the fish is more or less of a golden bronze, varying to green tones where it lives in masses of weeds in clear water. The St. Lawrence Musky lives in very clear streams and lakes and is gray and silvery to match. The Ohio River fish lives in water not quite so clear and may be more partial to the weed beds. Its color is largely a mixture of beautiful greens.

The color pattern of the Pickerel (Plate 4) is a rather regular arrangement of light spots on a darker background. The spots may be greenish-golden, pearly or yellowish and the background may vary from silvery to various shades of green. However great may be the changes in color, the pattern of the adult remains constant; that is, when it is spotted there are about the same number and size of spots in the same location. The spots do not seem to change place or size. When young, the Pickerel has about the same color pattern as all other young fish of the genus, as is shown in the upper figure of Plate 7. When it reaches a length of a little more than a foot, the bars on the flanks between the pectoral and ventral fins (see p. 13) begin to break up and lose their regularity. Finally they enclose light colored spots. This change spreads over the body rather rapidly, the bars disappearing on the tail last.

The color pattern of the Muskalonge, where it differs from that of the young, seems to be produced mainly by the closing of some color cells. It is quite probable that an adult St. Lawrence Muskalonge could, on occasion, show quite as strongly barred a color pattern as any from the Ohio River. The pattern of the Pickerel seems to be produced in a similar way. The oval light spots are produced by widening the light bars in some places and narrowing them in others. An adult Pickerel with the barred color pattern may have been in the habit of lying in a place where the lights and shadows are of that kind. A beautiful example of this was seen not long ago in the aquarium at Lincoln Park, Chicago. A tank of Pickerel from Homer, Minnesota, was being watched carefully to determine whether certain barred specimens were Pickerel or Northern Muskalonge. One of the specimens at first showed a plain barring about like that in

the upper figure of Plate 7. As it swam toward the front of the tank, it began to show ghostly traces of the ordinary spotting of the others. These faded again, leaving the fish barred. A few minutes later the fish suddenly changed its color pattern to the regularly spotted one shown on Plate 4. This specimen was then lost in the crowd, but it is likely that it changed back again because the number of barred individuals in the tank was seen to vary from two to four at different times that day.

These changes are produced by changes in the expansion of the color cells or "chromatophores" in the skin. These strange groupings of black coloring matter behave almost as though they were separate living creatures. They can contract until they become very small dots which can hardly be seen with a microscope, or they can spread out until they meet and produce a solid black. The changes are under control of the fish and can occur in a very short time.

The color pattern of the Chain Pike (Plate 5) may be considered as simply an exaggeration of that of the Pickerel, although it is produced in a rather different manner. If we consider the light spots of the Pickerel opened out until they practically cover the body, leaving only narrow, reticulated lines between, we shall have the ordinary color of the Eastern Pickerel or Chain Pike. The change from the barred to the network pattern seems to be produced by an actual migration of the color cells. It usually begins on the flanks between the pectoral (see page 13) and ventral fins. The cross bars change their direction, twist around irregularly and finally arrange themselves in the new pattern. This change extends rather quickly to the rest of the body and in a few weeks the pattern is entirely different.

If we considered the color pattern of the Chain Pike derived from that of the Pickerel we might think that the St. Lawrence Muskalonge had gone farther and discarded all but the knots of its pattern. It does not seem to get its spots in that way, however, but by the more simple method of merely pinching off small parts of the cross bars of its baby coloration.

HYBRIDS

There has been much discussion of the possibility of hybrids between the various species of pikes and pickerels. Largely on theoretical grounds, many have denied the possibility of such specimens in nature. Lately, however, there has accumulated a large body of evidence showing that hybridization is not only possible but is comparatively common among wild animals. In the region around Washington, D. C., hybridization seems to be the only explanation possible to account for the many specimens which seem to be intermediate between the Chain Pike and the Trout Pickerel. Indeed, there it seems likely that it is quite a common occurrence among many groups of fishes.

Several years ago two specimens were caught in the Dead River at Beach, Illinois, a short distance north of Chicago. It is known that Muskalonge have been planted in that stream. These two specimens are like ordinary Pickerel except that the scaling on the head is like that of the Muskalonge. It is quite possible that they are hybrids.

One specimen of Chautauqua Muskalonge sent to Field Museum from Bemus Point, N. Y., had a distinct patch of scales on the cheeks. It is possible that this may have been a hybrid.

In Cayuga Lake, N. Y., the Pickerel is native and very common. The Chain Pike is also very common in that lake. As the latter fish is not found in Lake

Ontario, it is supposed it came into the Finger Lakes region after the building of the Erie Canal. Occasionally specimens are found in that lake which do not seem to belong to either species. One of these was recently collected by Mr. George McNeill and is exhibited in Field Museum (Plate 6).

This specimen is so unusual in many ways that it is worthy of a special description. It is a male, 32 inches in total length and 26 inches to the base of the tail. It is reported that it weighed $7\frac{1}{2}$ pounds. There were 120 scales in a row from the upper angle of the gill opening to the middle of the tail. There were 14 fully developed dorsal (see p. 13) rays and 12 fully developed anal rays. It also had a dark bar under the eye and a black horizontal line through the eye. This is like the Chain Pike. In color of body it was mixed. There were small round spots like those of the Pickerel, but smaller. These were partly hidden by a faint barring like that of the Chautauqua Muskalonge. The body color had a brassy tint like that of the Chain Pike. The fins were bright red as in highly colored specimens of the Chain Pike. The shape of the body was not like either but much deeper and more rounded. The Chain Pike and the Pickerel are more or less square-sided, many of them being nearly rectangular in cross section. In shape, this fish resembles large, mature specimens of the Grass Pike. The color pattern, also, is like the one we might expect to find on very large Grass Pike. Specimens a foot long show some spotting on the flanks which is just like the spotting all over the body of this fish. All the pikes which are spotted begin to change pattern just where the Grass Pike usually stops. This supposed hybrid has the shape of a very mature fish. Except for the scaling on the gill covers and the size, this fish might have been identified as a very mature specimen of Grass

Pike; but there are no Grass Pike in Cayuga Lake. The supposed hybrid has the cheek scaling of the Pickerel except that there is a double row of scales down the front edge of the opercle, just behind the cheek. This is just the same arrangement of scales as was found in some hybrids which Professor George C. Embody of Cornell University produced artificially.

It is not possible to prove that the Ithaca specimen is or is not a hybrid. If Professor Embody can produce some more hybrids and raise them to the age where they will change to the color pattern of the adult we shall know more about the matter. At present we can only say that this specimen is one of the most gorgeously colored pickerels ever seen, that it has the appearance of a very old fish, that it combines distinctive characters of the two species which are found in the same waters and that it does not belong to any known species. A traveler returning from the interior of Africa or South America with so well marked a form would have no hesitation in describing it as a new species. We can hardly do the same because the fishes of Cayuga Lake have been studied so carefully for so many years that it seems necessary to find another explanation.

TECHNICAL TERMS

There are a few technical terms for which definitions may be desirable. The fish has five groups of fins: dorsal, caudal, anal, ventral and pectoral. The dorsal, caudal and anal are called "vertical fins." The ventral and pectoral are the "paired fins." The position of these fins is shown in the diagram (Fig. 1). In the pikes there is a single dorsal, anal and caudal fin. Other fishes may have more than one, although it is rather unusual to have more than one anal or caudal fin. In the Walleye (Plate 8) there are two dorsals,

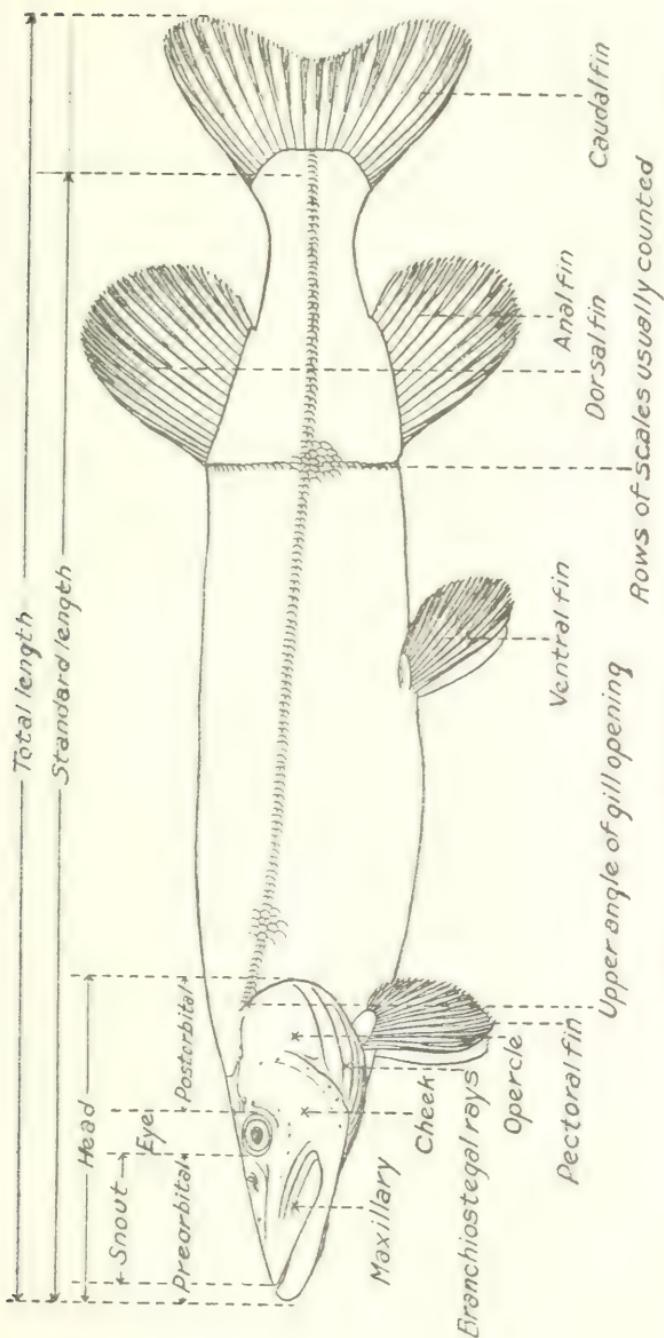


FIG. 1. Diagram of Pickerel, showing parts mentioned in description of fishes.

the first of "spines," the second of "soft rays" and one "spine."

The "total length" of a fish is the distance from the extreme front of the head, whether that is the tip of the lower jaw or the tip of the snout, to the end of the longest caudal rays. Because the tip of the tail is so easily broken off, it is usual in a scientific description to use the "standard length," which is measured to the end of the last vertebra or segment of the "backbone." In most fishes that is about opposite the very first rays of the caudal fin. The length of the head is the distance from the tip of the snout or of the lower jaw, whichever extends the farthest forward, to the end of the bony part of the opercle. The "snout" is the length from the front of the eye to the tip of the upper jaw. Where the lower jaw projects as it does in the pikes, the length of the snout is less than the preorbital part of the head. The "preorbital" is all that part of the head in front of the eye. The postorbital is all that part of the head which is behind the eye. The "cheek" is that part of the side of the head which is just behind and below the eye. It is part of the movable structure which makes up the side of the mouth and the gill cover. The "opercle" is the true "gill cover." It is that part of the side of the head which is behind the cheek and is usually marked off from it by a distinct groove.

The branchiostegal rays, more commonly called branchiostegals, strengthen and support the gill membranes below the cheeks and opercles. There must be great flexibility at that point to permit the swallowing of large prey and at the same time there must be stiffness to prevent collapse when the mouth opens in the act of breathing. Their number is quite uniform in the different species and furnishes one of the most reliable characters in separating groups.



ST. LAWRENCE MUSKALONGE.
Esox mitsquintonus Mitchell.

The number of rays in the paired fins is not usually counted in this group because it is difficult to do so satisfactorily and the final result seems to have little meaning. In the dorsal and anal fins, the short rays at the front are not counted. Only those are considered that reach to or nearly to the top of the fin. In practice this usually means that all the branched rays are counted and one or two of those which are jointed but not branched. In some specimens the front of the fin is gradually rounded so that it is hard to tell just where to stop. In such a case, even experts will not always count just the same.

There are two rows of scales which are usually counted. The first starts at the upper angle of the gill opening, or just above the pectoral fin in fishes where the gill opening does not extend so high, and follows the course of the "lateral line" to the base of the caudal fin. The other row starts at the front of the dorsal fin and extends diagonally backward to the anal fin. In either case, what is really counted is the number of rows of scales which cross the real or imaginary line which is being followed. In the pikes the lateral line is not often developed as a complete and single line of sense organs but the count is made where the line should be.

TEETH AND FOOD

Fishes have more tooth-bearing bones in the mouth than any other group of animals. The upper jaw is made up of maxillary and premaxillary. In the pikes, the premaxillary bears a row of small teeth. The maxillary is above and behind the premaxillary and forms most of the upper edge of the mouth opening. The pikes have no teeth on the maxillary and this is the only tooth-bearing bone in this group which is not so armed. In the center of the roof of the mouth just behind the premaxillaries is a long patch of teeth on the

vomer. On each side of the vomerine teeth and parallel with the maxillary bone is another patch of teeth on the palatine bones. All these teeth are hinged so that they offer no resistance to anything which is moving in the direction food is intended to go. When something intended for food tries to return, the teeth stand up against it.

On each side of the lower jaw is a row of several big, sharp teeth set firmly in the bone. These teeth are shed whenever they become worn or broken and it is this set which is supposed to be shed every summer when the Muskies are said to have "sore mouth" and to be "off their feed." However that may be, a big Northern Muskalonge in aquariums in Chicago has been in the habit of fasting for several weeks every summer.

There is a patch of hinged teeth on the base of the tongue of the pickerel and another similar patch on each joint of the gill arches. Behind the gill arches, at the entrance of the throat, is a broken ring of bony pads called "pharyngeal bones." Each of these also has a patch of fine, sharp, hinged teeth.

The shape and position of the teeth have a very definite relation to the kind of food a fish eats and to the manner of eating it. Students of evolution may (and do) discuss cause and effect, whether the kind of food determines the character of the teeth, whether the kind of teeth determines the character of the food or whether both are developed together and each determines the other.

A large Northern Muskalonge has been in aquariums in Chicago for several years. Small fish are eaten so quickly that it is not possible to watch the process, but a carp weighing between one and two pounds is not put out of the way so soon. When first seized, the carp is held across the mouth of the Musky,

pressed between the toothless maxillaries and the strong, solid teeth of the lower jaw. Then the Muskalonge returns to its usual resting place before taking the next step in the process. The fish is turned by a quick movement so that its head points down the throat of the big fellow. Then it is held between the tongue and the patches of teeth on vomer and palatines. In this position there can be very little sideways pressure and the fixed teeth are not needed for holding. The lower jaw is dropped so that the big teeth are out of the way and the prey is moved down the throat by a series of quick gulps until it finally disappears.

A small Grass Pickerel in the Lincoln Park aquarium had a slightly different method. Perhaps the small Goldfish was larger in proportion, although the relative sizes seemed to be about the same. The Pickerel was quicker and more positive in its movements. The Muskalonge was slower and more deliberate. The Pickerel seemed to try to catch the fish in the proper position at the beginning. It did not carry it away to a regular resting place. The motion in turning its prey was about the same except that it made two or three attempts before it got the Goldfish in just the right position. When the position was right, the first gulp took the smaller fish almost out of sight. The most noticeable difference was that the big teeth of the lower jaw were in use as long as there was any part of the Goldfish that they could grasp, and were released only at the moment of making another swallowing movement.

Some large Pickerel swallowed their prey in a similar manner. They seemed to have difficulty in turning their fish and often lost them if not secured in just the proper manner at the first attempt. One or two were swallowed tail first. Others were tried tail first and later rejected.

THE GROUPS OF PIKES

In North America there are three groups of "true pikes," belonging to the genus *Esox*, which makes up the family Esocidæ, as distinguished from the Pike-

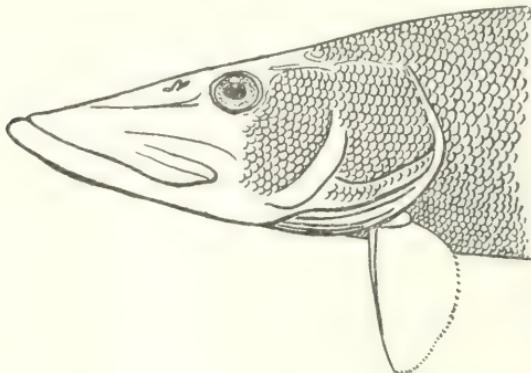


Fig. 2. Head of Grass Pickerel. Cheeks and opercles fully scaled.

Perch or Walleyed Pike, belonging to the genus *Stizostedion*, closely related to the European and Asiatic Pike-Perch or Sander, belonging to the genus *Lucio-*

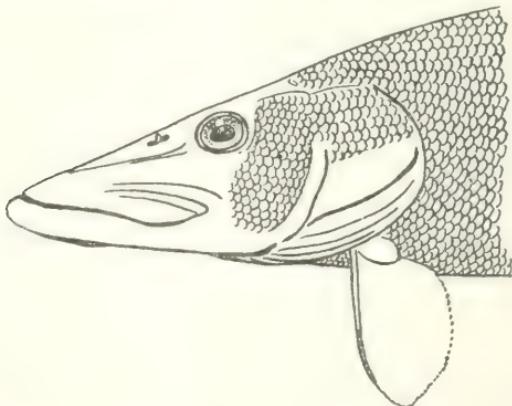


Fig. 3. Head of Pickerel. Cheeks scaled, opercles naked below.

perca, both of them belonging to the family Percidæ, which also includes the common Perch of Europe and Asia, our common Yellow Perch and the American

darters. The three pike groups may be conveniently separated by the distribution of the scales on the sides of the head as shown in the diagrams.

The first group includes two species, the Chain Pickerel (*Esox niger*) and the Trout Pickerel or Grass Pickerel (*Esox americanus*). They are small fish, mostly southern and eastern, which have the cheeks and opercles fully scaled (Fig. 2). None of these fish often reach a weight of more than five pounds and they are generally very much smaller. Along the Atlantic

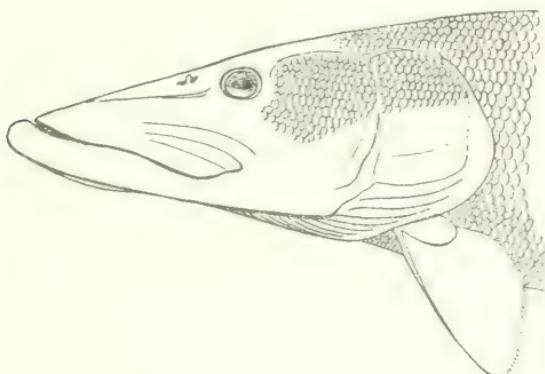


Fig. 4. Head of Muskalonge. Cheeks and opercles naked below.

coast, in Maine and New Brunswick, they may extend as far as 46° north latitude. They are found from there to Florida, west into Texas, up the Mississippi valley into southern Wisconsin, in Lake Michigan and the lower part of the Great Lakes.

The second group includes only one species, the Pickerel,* *Esox lucius*. This is a larger fish, frequently

* It may be worth while to note that the author began this investigation with the belief that there was some popular basis for following the lead of professional writers on angling subjects since "Frank Forrester" and calling this fish "Pike" as is done in England and Canada. Careful reading of many sporting magazines and much discussion with sportsmen has shown conclusively that, in the United States, *Esox lucius* is known universally as Pickerel and the word Pike, where used alone in ordinary conversation, always or almost always means Walleyed Pike.

weighing more than ten pounds, with the cheeks fully scaled and the lower half of the opercles naked (Fig. 3). This fish is found entirely around the world north of about 40° north latitude.

In the third group are found three closely related species: the Northern Muskalonge, St. Lawrence Muskalonge and Chautauqua Muskalonge, which have the lower part of the cheeks and opercles naked (Fig. 4). They are still larger fish, a weight of forty-five pounds being not uncommon and there seems to be some reason for believing that occasional specimens weighing more than twice that amount have been taken. Members of this group are found from northern Alabama to James Bay, east of the Mississippi River.

KEY TO SPECIES OF *Esox*

- A. Cheeks and opercles fully scaled.
 - B. Size small, seldom over one foot in length or a pound in weight. Scales large, usually less than 115 transverse rows between upper angle of gill opening and base of caudal rays. Dorsal rays 12-17. Anal rays 11-16. Branchiostegals 10-14.
americanus p. 21.
 - BB. Size larger, but seldom exceeding two feet in length or three pounds in weight. Scales smaller, usually more than 120 transverse rows between upper angle of gill opening and base of caudal rays. Dorsal rays 13-17, generally more than 14. Anal rays 13-16. Branchiostegals 12-17, generally more than 13.
niger p. 24.
 - AA. Cheeks fully scaled, opercles naked below the level of lower edge of eye. Size large, frequently reaching a weight of ten pounds or more. Scales about the same size as in *Esox niger*, 115-145 transverse series between upper angle of gill opening and base of caudal rays. Dorsal rays 15-20, mostly over 17. Anal rays

11-17, generally more than 13. Branchiostegal rays 13-16.

lucius p. 27.

AAA. Cheeks and opercles both naked below the level of lower edge of eye. Size large, frequently reaching a weight of thirty pounds or more. Scales small, usually more than 150 transverse rows between upper angle of gill opening and base of caudal rays. Dorsal rays 16-21. Anal rays 14-18. Branchiostegal rays 13-16.

C. Preorbital part of head equal to or longer than postorbital. Body heavily marked with dark cross bars. Ohio River and tributaries.

ohioensis p. 29.

CC. Preorbital part of head shorter than postorbital.

D. Body heavily marked with round, dark spots. Lower Great Lakes and St. Lawrence drainage, eastern Ontario, western Quebec, Vermont and northern New York.

masquinongy p. 29.

DD. Body marked with spots or cross bars or both. Markings usually very faint, stronger on the rear half of body and on tail. Upper Mississippi valley in Minnesota and Wisconsin, Lake of the Woods and northward to James Bay.

immaculatus p. 30.

LITTLE PICKEREL, TROUT PICKEREL,
GRASS PICKEREL, ETC.

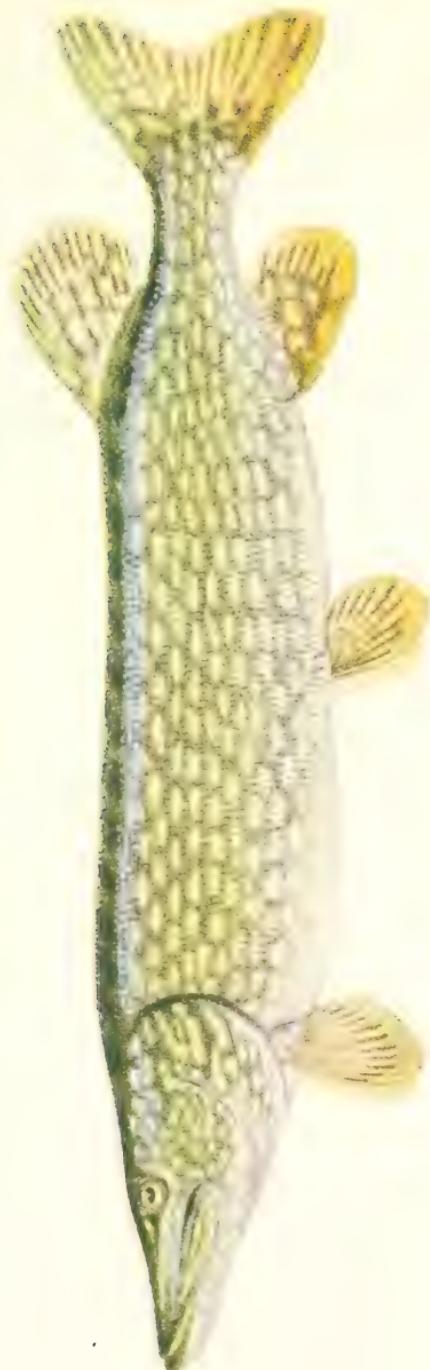
Esox americanus Gmelin—PLATE 7, Middle and Lower Figures.

EASTERN UNITED STATES

Small fishes, seldom over a foot in length or a pound in weight. Scales large, usually less than 115 transverse rows between upper angle of gill opening and base of caudal rays. Cheeks and opercles

fully scaled. Dorsal rays 12-17, not counting rudiments. Anal rays 11-16, not counting rudiments. Branchiostegal rays 10-14. Head variable, rather shorter than in other species. In all species of *Esox* the length of the postorbital part of the head is fairly constant, approximately 0.14 of the standard length. Variations in the total length of the head seem to be produced almost entirely by changes in the prolongation of the mouth parts. These changes are extreme in the present species. Specimens from the New England states (*Esox americanus americanus*) may have the postorbital length exceed the preorbital by as much as the length of the eye, while specimens from Lake Ontario (*Esox americanus umbrosus*) generally have the preorbital and postorbital lengths practically equal. The body and especially the head is usually noticeably deep and robust. The profile of the head in front of the eyes is straight or convex, rarely slightly concave. The color pattern is extremely variable, beginning in the young with dark blotches on the sides, varying to cross bands or narrow streaks, which may become irregular in width and direction and finally produce fairly even reticulations or become obsolete. Old specimens in certain locations are frequently almost solid very dark green above with irregular dark spots on the belly. These are often called Black Pike and supposed to belong to a distinct species.

Esox americanus is found from somewhere in Maine or New Brunswick southward into Florida, westward into Texas, up the Mississippi valley into southern Wisconsin and down the Great Lakes into western New York. It has been divided into two species, *americanus* and *vermiculatus*, largely on the supposition that there was a definite faunal boundary between them somewhere in the southern states. Since this has been shown not to be true and since there are



PICKEREL.
Esox lucius Linnaeus.

no salient characters separating them at any point, the two groups must be united. Specimens from the two ends of the range in Massachusetts and western New York are sufficiently distinct to be readily separated by average measurements but each of these groups is much less distinct from others in neighboring localities and these from others until there is found a fairly regular gradation from one to the other. The whole group can be divided, on the basis of average measurements, into a number of subspecies, varieties or local races of which might be mentioned *Esox americanus americanus* in the New England States and southeastern New York, *Esox americanus umbrosus* in the Great Lakes and *Esox americanus vermiculatus* in the Ohio River and its tributaries. There will be several others in the South Atlantic and Gulf States.

The most numerous pickerel in North America is, apparently, the least known. Where it is seen it is probably usually considered to be the young of one of the larger species. In its wide distribution from the cold streams of southern Wisconsin to the swamps of Florida there are naturally some slight differences in structure which may have some relation to variations in habits.

All the way from Maine to Florida these fish seem to have a great liking for small streams. In the vicinity of Washington, D. C., they are found far up some small brooks. On Long Island they live in the trout brooks. Along our western streams and lakes they are found mostly in muddy sloughs in the marshes. Sometimes they may be seen in small streams but not often above the first bit of swift water.

Within recent years a number of anglers have reported that the Trout Pickerel is good game for the fly fisherman. Mr. Louis Rhead tells of catching them in the trout brooks of Long Island and says that they seem

just as game as the Brook Trout of the same waters. Other writers are not quite so favorable. A few say that it might be a good game fish if larger. One or two call it "delicious." The majority, however, agree with the writer who says that this fish, on Long Island, often causes trout fly fishermen much trouble by taking the fly intended for "nobler" fish. Two specimens, received at Field Museum, were caught by Mr. Rhead. In the letter accompanying them, Mr. George P. Engelhardt, of the Brooklyn Museum quoted Mr. Rhead as saying: "These fish readily rise to a fly and are equally as game as a Brook Trout." Again he says: "Mr. Rhead told me that both were caught on a fly while fishing for trout and that the larger of the two specimens jumped at least a foot out of the water in taking the fly." In a letter to the author, Mr. Rhead says: "It is a gamey little fish, rises to the fly, sometimes leaps above the surface, quite as active as a trout."

It is not at all likely that this fish anywhere reaches a length greater than twelve to fifteen inches or a weight which will go much above a pound. The statement in Goode's "American Fishes" (page 282) that the "Western Pickerel" has been known to attain the weight of twenty pounds but at the present day never exceeds seven or eight must, almost certainly, refer to the Ohio Muskalonge. Specimens nearly fifteen inches in length have been taken in the Illinois River and neighboring bayous at Meredosia, Illinois, within the past few years.

CHAIN PICKEREL, EASTERN PICKEREL, ETC.

Esox niger Le Sueur—PLATE 5.

EASTERN UNITED STATES

Larger than *Esox americanus*, but seldom exceeding 5 pounds in weight. Scales smaller than in *americanus*, usually more than 120 transverse rows between

upper angle of gill opening and base of caudal rays. Cheeks and opercles fully scaled. Dorsal rays 13-17, generally more than 14, not counting rudiments. Anal rays 13-16, not counting rudiments. Branchiostegal rays 12-17, generally more than 13. Head long, the extension of the preorbital part especially pronounced. In many specimens, especially northern, the preorbital part of head may exceed the postorbital by as much as the length of the eye. Southern specimens often have the preorbital part of head shorter. Young individuals may become almost indistinguishable from *Esox americanus*. In a few extreme cases it is difficult to separate very old specimens of *americanus* from small adults of the present species. The body and head are notably long and slender. The appearance of slenderness is increased by the concave profile of the top of head, in front of the eyes. The color pattern of the young is very similar to that of *americanus* but the markings are usually somewhat coarser. At a length somewhat less than a foot the markings change to a more or less regularly reticulate pattern on a lighter background. Southern specimens often become solid dark green in color above with irregular dark spots on the belly and are called Black Pike. Short-headed specimens in the dark phase or with rather fine reticulations are often very difficult to separate from similarly marked specimens of *americanus*.

Esox niger is found from somewhere in Maine or New Brunswick southward into Florida, westward to Texas and up the Mississippi to northern Arkansas or southern Missouri. It has not yet been recorded from any of the Great Lakes although it is in several of the streams flowing into Lake Ontario and the St. Lawrence River. Apparently it found its way into these streams through the extensive system of canals which was in use in New York state before the beginning of

railroad operation. From eastern Massachusetts to South Carolina this is an important game fish.

This fish is the largest species which has the cheeks and opercles fully scaled. In number of scales and of dorsal and anal rays it is very much like the Pickerel. The main points of difference in general appearance are that the jaws are decidedly longer, the body more slender and the color yellowish or brassy. The color pattern is similar except that the light spots are proportionately larger so that the impression is of a golden or brassy colored fish with dark lines forming a network over the body. In the Pickerel the impression is of a greenish, gray or silvery fish with golden, light green or pearly spots. The color change from youth to the adult condition occurs at a smaller size than in the Pickerel. Young specimens and those just starting to change may be very difficult to distinguish from Trout Pickerel of the same size. In that case the great length of the jaws and the slenderness of this species are the best characters to use.

As with all the rest, there is great difference of opinion with regard to its quality as food or game. Various writers in the "American Angler" between 1880 and 1890 claimed that the "Yellow Pickerel" of Oneida Lake, New York, was the best fish to eat and one of the best game fish they had ever seen. Other writers have been just as positive that the flesh of this fish is watery and tasteless. About thirty-five years ago, the Chain Pickerel seems to have been about as highly esteemed as the Black Bass in Greenwood Lake, of New York and New Jersey. In a recent letter Mr. Louis Rhead says: "The Chain Pickerel of Long Island, which I catch up to 24 inches, is a beautifully colored fish—also *leaps above the surface*. I never before got them anywhere on the northern continent either so gamey or highly colored in green and yellow."

Such a great difference must be other than accidental and is probably due to differences in the water or the food or both.

PICKEREL, PIKE, JACK, ETC.

Esox lucius Linnaeus—PLATE 4; PLATE 7, Upper Figure.

NORTHERN LAKES AND RIVERS

Large fishes, often exceeding a weight of ten pounds. Scales about the same size as in *niger*, 115-145 transverse series between upper angle of gill opening and base of caudal rays. Cheeks fully scaled. Opercles naked below the level of lower margin of eye. Dorsal rays 15-20, not counting rudiments, mostly over 17. Anal rays 11-17, generally more than 13. Branchiostegal rays 13-16. Head variable, American specimens (*Esox lucius estor*) having the preorbital part of head longer than the postorbital. The two are equal in European specimens (*Esox lucius lucius*). Changes in the body contour are very great in this species. Young specimens are very slender and are frequently called "Snakes" in Wisconsin and northern Michigan. Large, old specimens, which have been able to get plenty of food, often become very deep-bodied. The profile of the head in front of the eyes is usually straight but may be slightly concave or convex. In general, among the species of this family, there seems to be a tendency for the profile to be convex when the snout is short and concave when it is elongated. The color pattern is very uniform in this species. Young specimens have a pattern very much like that of young *americanus* of similar size, but slightly coarser. Older ones develop a pattern much like that of *ohiensis* or less spotted individuals of *immaculatus*. Still later the light cross bands become irregular along their edges and finally change into diagonal rows of horizontally elongated light spots on a darker background. The

shape of the spots makes them appear to be arranged in horizontal rows but a little careful measurement shows that this is an illusion. The spots are really the remnants of the cross bands of the color pattern of the young and are arranged in rows having the same slightly diagonal direction. The change in color pattern usually occurs when the fish is less than fifteen inches long but may be delayed until much later. There is some reason for believing that it is within the power of the fish to change back from the spotted to the barred coloration at will, especially while young.

Esox lucius is found entirely around the world, north of about 40° north latitude. The only extensive areas where it seems to be not known, in that region are Greenland, Iceland, Spain and Portugal. In North America it is found in streams flowing into Bering Sea, the Arctic Ocean, Hudson Bay, the Atlantic Ocean and the Gulf of Mexico. It has been planted in streams flowing into the Pacific. Throughout this wide range it is well known as a food and game fish and has received a host of names and nicknames.

Writers on fishing subjects have been telling about the Pickerel for hundreds of years and it would seem that there is little either of fact or fable to tell. The older writers, especially, were full of tales of the terrible ferocity of this fish. Modern writers seem to be more concerned with the question of the proper name by which to call it or else with the question of its possession or lack of game qualities. Opinion seems to be about equally divided between calling it one of the best or one of the worst game fishes. Heavier tackle is generally used for Pickerel than for the basses. This has much to do with an apparent lack of game qualities. Then, too, the Pickerel is very slender and lacks the great resisting surface of the bass. Its fight must be made by sheer muscular force.

CIAUTAUQUA MUSKALONGE, OHIO MUSKALONGE, ETC.

Esox ohioensis Kirtland—PLATE 2.

OHIO RIVER AND TRIBUTARIES

Size large, weight frequently exceeding thirty pounds. Scales small, usually more than 150 transverse rows between upper angle of gill opening and base of caudal rays. Cheeks and opercles both naked below the level of lower margin of eye. Dorsal rays 16-21, not counting rudiments. Anal rays 14 to 18, not counting rudiments. Branchiostegal rays 13-16. Head moderate, the preorbital part equal to or longer than postorbital. Body slender in the young, becoming deep and robust with age. The color pattern at all ages is practically the same as that of *Esox americanus* except that there seems to be much less tendency for the cross bands to lose their straight course and become vermiculate or reticulate. In very old specimens there is some tendency for the dark cross bars to break up into vertical rows of dark spots as the similar light bars of *lucius* break up into light spots. In *lucius* this change seems to start on the flanks, between the pectoral and ventral fins. In all three species of Muskalonge the similar change starts on the tail.

Esox ohioensis is found in the Ohio River and its tributaries, from western New York to northern Alabama and western North Carolina. In the southern streams where this fish is called "Pike," the Walleye (*Stizostedion*) is generally called "Salmon."

ST. LAWRENCE MUSKALONGE, SPOTTED MUSKALONGE, ETC.

Esox masquinongy Mitchill—PLATE 3.

GREAT LAKES AND ST. LAWRENCE

Size large, weight often more than forty pounds. Scales small, usually more than 150 between upper

angle of gill opening and base of caudal rays. Cheeks and opercles naked below level of lower margin of eye. Dorsal rays 16-21, not counting rudiments. Anal rays 14-18, not counting rudiments. Branchiostegal rays 13-16. Head moderate, preorbital part shorter than postorbital. Body deep, especially in old individuals. Young specimens of this species are not available for study but there is no reason to believe that they are different in color pattern from other species of the group. In adults, the dark bars have been reduced to rows of round or vertically elongate dark spots on a lighter background.

Esox masquinongy is found in the lower Great Lakes, in the St. Lawrence River, in the rivers of northern New York and Vermont flowing into Lake Ontario or the St. Lawrence north and east of Oswego and in the rivers and lakes of southeastern Ontario and southwestern Quebec.

NORTHERN MUSKALONGE, UNSPOTTED MUSKALONGE, WISCONSIN MUSKALONGE,
ETC.

Esox immaculatus Garrard—PLATE 1.

UPPER MISSISSIPPI AND NORTHWARD

Size large, weight often more than forty pounds. Scales small, generally more than 150 transverse rows between upper angle of gill opening and base of caudal rays. Cheeks and opercles naked below level of lower margin of eye. Dorsal rays 16-21, not counting rudiments. Anal rays 14-18, not counting rudiments. Branchiostegal rays 13-16. Head moderate, preorbital part shorter than postorbital. Body deep and robust in the adult, slender in the young. The color pattern is variable, sometimes consisting of cross bars like *Esox ohioensis*, sometimes of spots like *masquinongy* and sometimes of both spots and cross bars. Where spots



CHAIN PICKEREL.
Esox niger L. Smith.

and bars are present they seem to have no relation to each other. A large fish market specimen showed spots when viewed from certain angles and bars from other angles. The spots might be in, between or on the edge of the bars. Occasional specimens, locally called "Tiger Muskalone," may have the spots or bars very distinct but generally the markings are very indistinct except on the tail, where they can be easily seen. Over most of the body they can only be seen on careful examination in a good light and when viewed at a certain angle.

Esox immaculatus is found in the headwaters of the Mississippi above the junction of the Minnesota and in streams entering on the east side above the Illinois-Wisconsin line. Northward it occurs across the divide in Lake of the Woods and Rainy Lake. If the accounts of sportsmen are accurate, this species is found in suitable waters clear to James Bay.

Of all our freshwater game fish, the Muskalone seems to be most difficult to recognize, apparently not because of any lack of distinguishing marks, but because the differences are of a kind that the fisherman usually overlooks. The two Black Basses really look more alike than the Pickerel and Muskalone, yet the latter pair are much more often confused. Guides and resort hotel keepers have not always helped by their identifications of large fish. The actual capture of a fifteen pound Pickerel may have been just as difficult as the taking of a Muskalone of the same weight but many fishermen would feel very differently if told the truth. In other words, the Muskalone is fashionable and the Pickerel is not, even though it may fight just as hard.

There are three groups of Muskalone, which, for convenience, we may consider three species. To understand their relationships and distribution we must

know a little about the past history of North America. There is very good evidence for believing that at several times in very recent geologic history the northern part of this continent, extending sometimes as far south as the Ohio River, was covered with a vast sheet of ice, a glacier, like those which now cover Greenland and the Antarctic continent. Just south of Lake Superior, in what is now the state of Wisconsin, was a curious island in the sea of ice. This island, called by geologists the "driftless area," included parts of the present courses of the Mississippi and Wisconsin Rivers, and the mouth of the Minnesota River.

It is evident that no fish could exist where the ice sheet covered everything, pushing the earth away from the bare rocks. All the fish that formerly lived there must have been destroyed or driven south. We believe that there were Muskalonge living in part or all of the region now included in the Great Lakes Basin and the upper Mississippi Valley. Some of them, no doubt, stayed in the "driftless area." The others must have been forced farther and farther south until they reached the Ohio and the lower Mississippi. There they survived until some change produced a warmer climate and the ice began to "retreat." Retreat is not a good word for the process; there was no sliding back of the ice on its rocky foundation. It continued to advance during the whole retreat. The only difference was that the heat of each summer or the average of all the summers melted more of the ice than the glacier pushed forward during the whole year. Thus the ice front retreated although the ice itself was pushing forward all the time.

As the warm weather pushed back the front of the glacier it finally passed over the divide into a region which slopes to the north. Still the ice was so thick that the water could not escape in that direction and

was backed up until it could flow over the divide and into some stream flowing southward. Such an overflow channel formerly existed where the south end of Chicago is now, the water going into the Illinois River. Many others are known but the one most interesting to us just now is the one where the water from the valley of the Red River of the North flowed over into the Minnesota River. The lake was many times larger than Lake Superior. It extended to the southeast to include Lake Winnipeg, Lake of the Woods and Rainy Lake. To the westward it included the lake region of central Saskatchewan. Thus there was an open water route for the Muskalonge of the "driftless area" to follow the glacier to the north. Also, the water from the glacier passed through a great settling basin so that there is little doubt that the Minnesota was at that time a clear cold stream. At present we find the Northern Muskalonge (Plate 1) living in streams flowing through the driftless area and in clear waters flowing away from the site of this former lake. It is not found in the Minnesota probably because that river is now a muddy prairie stream.

While the ancestors of the Northern Muskalonge were shut in the "driftless area" another part of the original group was forced southward ahead of the ice until they finally entered the Ohio River and its tributaries from the south. Some of the more important of these are the Kentucky, Green, Cumberland and Tennessee Rivers. As the ice melted back these fish found themselves in pleasant surroundings and stayed. They had to adapt themselves to changes of temperature and other conditions as the country was transformed from something which must have appeared much as northern Labrador does today. The Chautauqua Muskalonge or Ohio Muskalonge (Plate 2) is found in all parts of the Ohio River basin, from the headwaters of the Tennes-

see in the French Broad River at Asheville, North Carolina, and from northern Alabama on the south to Chautauqua Lake at the head of the Ohio on the north.

The third group, the St. Lawrence Muskalonge (Plate 3), is found now in northern New York, in eastern Canada and in the Great Lakes drainage from Lake Huron down. They are evidently descended from ancestors of one or both of the other groups for their country was covered by a heavy sheet of ice for a long time. As the ice melted back there were constant changes in the position of the streams that carried away the water; lakes were formed and abandoned; lake outlets were first into one stream and then into another. It was easy for fish to follow the glacier back and to cross the divides from one stream system to another until they reached the country where we find them now. It is probable that the fishes of Lake Erie and eastward are descended from those that lived in the old Ohio River. Those of Georgian Bay and parts of southeastern Ontario may have descended from either, or both.

It may seem that the limits of the range of the various species of Muskalonge are rather indefinite. The Chautauqua Muskalonge and the Northern Muskalonge are in different parts of the Mississippi basin. The Northern Muskalonge and the St. Lawrence Muskalonge are found in different parts of the Great Lakes basin. There is deep water which could permit free movement from one to the other. However, it does not seem that the fish do move so. No Muskalonge likes muddy water. Below the northern boundary of Illinois the Mississippi is so cloudy with the silt of the prairie rivers that it seems to form an effective barrier. On the other hand, the Muskalonge do not seem to like large lakes. They prefer small, shallow, sheltered

bays, where they can lurk under the shelter of water plants and not be disturbed by the pounding of heavy waves.

WALLEYED PIKE, SAUGER, YELLOW PIKE, BLUE PIKE, DORY, DOREE, ETC.

Stizostedion vitreum Mitchell, *Stizostedion canadense* Smith, etc.

PLATE 8.

EASTERN NORTH AMERICA

Spiny-rayed fishes with two dorsal fins, the first with 12 to 15 spines, the second with 1 spine and 17 to 21 soft rays. Anal fin with 2 spines and 11 to 14 soft rays. Ventral fins thoracic (close to the pectorals), with 1 spine and 5 soft rays. Scales ctenoid (having small sharp spines along their edges). Color variable, yellowish, bluish or grayish, with or without dark spots or blotches or finer markings, sometimes decidedly pinkish in the saugers. The body is slender and the mouth large as in the pikes but in essential structures this fish is very close to the Yellow Perch.

One or more species of this group are found in all suitable waters from northern Louisiana and Texas northward to the lakes of the Barren Lands, east of the Rocky Mountains. They are exceedingly numerous in many of the larger lakes of Canada.

The differences between the Walleyed Pike and the saugers are very small, consisting of a little difference in shape of body, some differences in the extent of scaling on the head and a difference in the number and arrangement of the caeca or blind sacs attached to the stomach. Of these the Walleye has three, all about the same length and about as long as the stomach. The saugers have from 3 to 7 or more, usually of different lengths and none as long as the stomach. This is the only certain way of separating the species. The head of the sauger is usually broad and flat. That of

the Walleye is usually narrow and high. The sauger often has a pattern of dark saddle-shaped blotches on a pinkish background. The Walleye usually has a pattern of very fine dark markings on a background of yellow, blue or gray. That these differences are not constant may be seen from the fact that a fish has been seen to change from one color to the other in a fraction of a second.

These fish are related to the pikes only in name. They are true perches, with sharp spines in the fins and with rough, "ctenoid" scales. There are three groups of perches as there are three groups of pikes. The Yellow Perch, in three or four closely related species, is found all around the world in northern latitudes. The Pike Perches, in several species, are also found all around the world in northern latitudes. There are three or four species in North America, so closely related that fishermen who recognize the differences often make mistakes. The third group is that of the darters of our streams. This group of little fishes (only one out of a hundred or more species reaches a length of six inches) is found only in the streams and ponds of North America.

The Walleyed Pike (Plate 8) is like the Pickerel in having a similar shape, in eating mainly living food of large size and in living in similar places. In name, however, the two are so completely tangled that it is almost a hopeless task to try to separate them. When a Chicago angler says he caught a six-pound Pike, it often requires considerable discussion to find out whether he caught *Stizostedion* or *Esox lucius*. North of the Great Lakes the name "Pickerel" almost invariably means *Stizostedion*. On this side it is almost as invariably applied to *Esox lucius*. Some years ago the "American Angler" devoted many pages to a discussion of that point.

There are three or four species of *Stizostedion* in North America, the Walleyed Pike and two or three species of Saugers. The Walleye grows to a weight of more than fifteen pounds while the Saugers seldom pass two or three pounds. They are very similar in habits and habitat as well as in general appearance. Alive in the aquarium, they are usually fairly easy to separate but in the fish market or in the alcohol jar of the museum it frequently requires dissection and an examination of the internal organs to decide which species is represented by any particular specimen.

In the aquarium the Sauger is more often seen resting on the bottom while Walleyes of the same size will be found more often in mid-water. There is usually also a difference in color and color pattern. The Walleyes will have a bluish color produced by a fine-grained mottling of light and dark. These small fish are often called Blue Pike and are sometimes thought to be a distinct species. In the same lighting the Saugers will have a pinkish color with a rather regular arrangement of saddle-like dark blotches on the back. This is not an absolute character, however. A specimen has been watched in the aquarium, swimming slowly in a vertical circle, with a short rest on the bottom of the tank after each circuit. While resting on the bottom or swimming close to it, it had typical Sauger color. When it turned to swim upward it changed to the Walleye color, which it retained until it came back to within four or five inches of the bottom, when it changed back to the Sauger color. This regular succession of color changes, Walleye, when more than about five inches from the bottom and Sauger the rest of the time, was kept up for a half hour or more.

The Walleyed Pike is found in North America in practically all the suitable waters in the Mississippi basin, the Great Lakes and northward. Its northern

limit is not yet known. It is an important commercial fish in Lesser Slave Lake, Lake Winnipeg, Lake of the Woods and the Great Lakes. It is generally esteemed as a game fish in the waters where it can be caught by game fishing methods. There are many places where it is present in large numbers but can hardly be induced to take a baited hook. As a food fish it is one of the best.

COMMON NAMES

In Chicago, a fisherman speaking of "Pike" usually means Walleyed Pike, *Stizostedion*, (page 35). If he says "Pickerel" he generally means *Esox lucius* (page 27), but may mean *Stizostedion*, *Esox niger* (page 24) or *Esox americanus* (page 21). If such a fisherman should tell of catching "Pickerel" and "Pike" he would probably refer to *Esox lucius* and *Stizostedion*, while his friend from some city in Canada, a short distance east of Detroit would use the same terms to mean *Stizostedion* and *Esox lucius*. If the same Chicago fisherman should use the term "Great Northern Pike" it would be almost impossible to tell whether he meant *Esox lucius* or *Esox immaculatus* (page 30). This is probably the worst mixup on record. Apparently about half the fishing population of northwestern Wisconsin and northeastern Minnesota use the name "Great Northern Pike" for large specimens of *Esox lucius*, especially those showing some red color in the fins, while the others give the name to a Muskalonge, *Esox immaculatus*.

The confusion of names has become so serious that fish dealers in Chicago have practically abandoned the names "Pike" and "Pickerel." For *Esox lucius* they use the name "Jack." *Stizostedion*, according to size, are "Yellows" or "Blues." Large specimens of Wall-eyed Pike generally have more or less of a brassy color

LEAFLET 9.

PLATE 6.



HYBRID PICKEREL.

and are known by the trade name "Yellow Pike." Smaller ones are bluish in general tone and are called "Blue Pike."

Another source of much discussion has been the name "Muskalonge." There are at least forty legitimate spellings divided into two general groups, those which derive it from Indian words which have been spelled "*Mas-kinonge*" or "*Mas-kenoza*," and those which derive it from French words "*masque-allongé*." Feeling free to choose any of these spellings we have selected "Muskalonge" because it comes the closest to the way it is generally pronounced, because it is one of the commonly accepted forms, and because it has relatively simple spelling.

There are two ways to consider common names of any objects with which people are familiar. One is to hold absolutely to the name first given. That is the way of scientific nomenclature. Some confusion has arisen because we do not always know which was the name first applied but such difficulties are being removed as fast as possible and will finally be taken care of by the establishment of a list of accepted scientific names. The other way is to hold that the name of an object is what folks call it. Many writers of books on this group have refused to accept this view and have tried to secure the use of unfamiliar or, even, newly made names. This has rather added to the confusion. Under either interpretation, the name "Pickerel" without any qualifying word is not available for the strictly American species with the cheeks and opercles (see p. 13) entirely scaled, because this name is not commonly so used in America and because it was first applied to *Esox lucius* before anyone in Europe knew that there was such a place as America.

The number of common names is a fairly reliable index of the extent to which a fish attracts public at-

tention. It is not necessary that the fish shall be present in great numbers but only that there shall be some quality which sets it off from others. The Gizzard Shad is present in incredible numbers in all the fresh and brackish water from Minnesota to Texas but it has hardly any name except Shad or Gizzard Shad in all that area. In the same region there is possibly not one fish of the Pikes and Pickerels for every million Gizzard Shad yet this smaller group numbers its names by the dozen, because Shad, no matter how numerous, are only a lot of silvery fish but the Pike or Pickerel, no matter how small, is unusual and must be noticed, if seen.

In this article an attempt has been made to bring together all the names that have been used for the pikes, pickerels, muskalonge, Walleyed Pike and saugers. The last must be brought in because about half the names of the group of Walleye and Sauger have the word pike or pickerel included in some way and nine of their names are among the commonest names of the pikes, pickerels or muskalonge. It is evident that this is not the entire list. Careful study would probably show that more than two hundred names have been or are applied to this group of seven or eight fish. The names are grouped in two ways. Under the scientific name of each fish is given a list of all the names belonging to that species. Under each common name is given a list of all the species to which it has been given.

The following list of names is presented in the belief that the name in common use is the correct one, where it is in common use; that is, where it is part of the language of every one. The man who has been taught all his life that a certain fish is a Pickerel must stop to think, at least a fraction of a second, before he can call it a Pike. If he has a dictionary which tells

him that a man from a certain other place always calls that fish Pike he can translate as the other man talks.

For the sake of uniformity it is necessary that the author express his preference in the matter of names for these fish. They are:

Esox lucius: Rivers and lakes around the world north of about 40° north latitude; PICKEREL, PIKE, JACK.

Esox masquinongy: Upper St. Lawrence River, lower Great Lakes, rivers and lakes of Ontario and western Quebec; MUSKALONGE, ST. LAWRENCE MUSKALONGE.

Esox ohioensis: Ohio River and its tributaries in New York, Pennsylvania, Ohio, Indiana, Illinois(?), West Virginia, Kentucky, Tennessee, Mississippi(?), Alabama, North Carolina and Virginia(?) ; CHAUTAUQUA MUSKALONGE, OHIO MUSKALONGE.

Esox immaculatus: Rivers and lakes of northern Wisconsin and Minnesota in the Mississippi basin and northward to Hudson Bay; NORTHERN MUSKALONGE, WISCONSIN MUSKALONGE, UNSPOTTED MUSKALONGE.

Esox niger: Rivers and lakes from New Brunswick to Florida, Louisiana, Texas and Arkansas; CHAIN PIKE, CHAIN PICKEREL.

Esox americanus: Rivers and lakes from Maine to Florida, Texas, Illinois, Michigan and down the Great Lakes to New York; TROUT PICKEREL and LONG ISLAND PICKEREL in the East, GRASS PICKEREL and LITTLE PICKEREL in the West.

Stizostedion: Rivers and lakes of North America east of the Great Plains and north of Texas; WALLEYE, WALLEYED PIKE, SAUGER. There are three species mixed up in this group, but they are so closely allied

that it is practically impossible to separate them. Anglers and fishermen will always call large specimens of both species Walleye and small ones Sauger, without much reference to which species is concerned.

LIST OF SCIENTIFIC NAMES WITH CROSS REFERENCES.

Esox

A few names found in the books and elsewhere clearly belong to this group but can not be referred to any one species.

Grass Pickerel; Mallett's Bay, Vermont.

Jackfish; Pond twelve miles north of Houston, Texas.

Long Face; Maine.

Silver Pike; Northern Michigan eastward to Georgian Bay.

Tiger Muskalonge; Wisconsin (probably usually *Esox immaculatus*, but occasionally surely *Esox lucius*).

Esox americanus

Banded Pickerel; Massachusetts to New Jersey and occasionally elsewhere.

Ditch Pike; New Jersey.

Grass Pickerel; general, especially western.

Grass Pike; general, especially western.

Humpbacked Pickerel; Waterford, Oakland County, Michigan.

Jack; North Carolina.

Little Pickerel; general.

Little Western Pickerel; general.

Long Island Pickerel; southeastern New York.

Mackerel Pike; a book name proposed from southeastern New York but not in use recently.

Mountain Trout; Spring Valley Creek, Shannon County, Missouri, R. E. Call.

Mud Pike; New Jersey.

Piccanau; Indian. This name is recorded by Goode in "American Fishes." Apparently that author was confused in his identifications and his "Western Pickerel," which is said to reach a weight of twenty pounds in Mississippi, was probably *Esox ohioensis*.

Pickerel; a book name which has wide circulation in literature but which has hardly come into the common speech of fishermen.

Pike; this seems to be a fairly well distributed common name from eastern Maryland to Florida.

Pond Pickerel; occasional from Maine to southern New York.

Pond Pike; reported by G. B. Goode in "American Fishes" but locality not given.

Red-Finned Pike; North Carolina.

Short-Billed Pike; New Jersey.

Smaller Pickerel; New England.

Trout Pickerel; New England States and western Pennsylvania.

Troutnose Pickerel; New England (?).

Varied Pickerel; southern New York.

- Western Pickerel; general.
 Western Trout Pickerel; western Pennsylvania.
 Yearling Pickerel; Sodus Bay, New York.
- Esox immaculatus*
 Barred Muskalone; Wisconsin.
Chautauquay Lake Pike; This name was mentioned in the "American Angler," vol. 15, p. 17. It is probably a misprint for Chautauqua Lake Pike and may refer to *Esox ohioensis*.
 Great Northern Pike; northwestern Wisconsin.
 Longe; general.
 Lunge; general.
 Muskalone; general, see under *Esox masquinongy* for about forty ways of spelling this name.
 Musky; general.
 Northern Muskalone; substitute proposed for Unspotted Muskalone.
 Plain Muskalone; name proposed by Becker.
 Tiger; Wisconsin.
 Tiger Muskalone; Wisconsin.
 Tiger Musky; Wisconsin.
 Unspotted Muskalone; Wisconsin.
 Unspotted Pike; Lake Pepin; perhaps used as a description rather than a name. Quoted in "American Angler," vol. 9, p. 387.
Wasserwolf; name used by O. W. Smith for all the species of Muskalone.
 Wisconsin Muskalone; Wisconsin.
- Esox lucius*
Brochet; France.
 Canada Pike; Ontario, Canada.
- Channel Pickerel; Thousand Islands, St. Lawrence River.
Chuk-Whuk; Alaska Indians.
 Common Pike; general.
 Duck-Billed Pickerel; Illinois-Wisconsin.
 Duck-Billed Pike; Illinois-Wisconsin.
Eithinyoo - *Cannooshæoo*; Creek Indians in Canada.
 English Jackfish; Ontario, Canada.
 English Pike; Ontario, Canada.
 Grass Pickerel; Illinois.
 Grass Pike; Western Pennsylvania (?).
 Great Lake Pickerel; no locality (Thaddeus Norris).
 Great Lakes Pike; northern United States.
 Great Northern Lake Pickerel; no locality (Thaddeus Norris).
 Great Northern Pickerel; northern North America.
 Great Northern Pike; Wisconsin.
 Great Pike; name proposed by O. W. Smith.
Hecht; Germany.
 Jack; Chicago Fish Markets and parts of Canada where *Stizostedion* is called Pickerel.
 Jackfish; Manitoba.
 Lake Pickerel; Northern Ohio.
 Lake Pike; Western Pennsylvania.
Luccio; Italy.
 Marsh Pickerel; Thousand Islands, St. Lawrence River.
 Luce; England.
 Northern Lake Pike; No particular locality indicated.

Northern Pike; No particular locality indicated.	Maskalingé
Pickerel; northern United States, Canada where <i>Stizostedion</i> is not called Pickerel, England (young fish).	Maskallonge;
Pike; general in northern United States and Canada where <i>Stizostedion</i> is not called Pike; England (adult fish). In North America it almost always is used as a book name. The angler generally has a local name which he uses unless he is "talking up" to a visitor.	Maskalongé;
Short Pickerel; Thousand Islands, St. Lawrence River.	Maskalongé;
Shovelnose Pike; northern Michigan and western Ontario.	Maskanonge;
Silver Pike; northern Michigan (?).	Mas-ke-non-ge;
Slinker; St. Lawrence River region.	Maskenonza;
Snake; Wisconsin.	Maskenonzay;
Snake Eater; Cheboygan, Michigan.	Maskenosha;
<i>Wasserwolf</i> ; Germany.	Maskenozha;
Yearling Pickerel; Sodus Bay, N. Y. (young).	Mas-Kinoje;
 Esox masquinongy	
Black-Spotted Pike; a name published in sporting magazines by General Garrard, perhaps intended more as a description than as a name.	Masquinongy;
Blue Pike; Western Pennsylvania (?).	Muscalingga;
Great Pike; general.	Muscallonge;
Kinongé; eastern Canada.	Muscallunge;
Longe; general.	Muskallonge;
Lunge; general.	Muskallunge;
Mascallonge;	Muskallunge;
Mascalonge;	Muskallunge;
Mascalongé	Muskallunge;
Mascanongy;	Muskallunge;
	all these variations of the spelling of this name have been published and have received more or less recognition.
	Musky; general.

Pike; the use of this name for a Muskalonge is probably entirely obsolete, except for *Esox ohioensis*.

Spotted Muskalonge; New York.

Wasserwolf; name used by O. W. Smith for all species of Muskalonge.

Esox niger

Black Pike; Dismal Swamp and other regions of black water along the south Atlantic coast states.

Chain Pickerel; rather general, but has little currency outside of books.

Chain Pike; mostly a book name of rather wide application.

Common Eastern Pickerel; New Jersey.

Duck-Billed Pike; North Carolina.

Eastern Pickerel; New York. Federation Pike; Oneida Lake, New York.

Green Pike; Pennsylvania.

Jack; North Carolina to Florida.

Jackfish; Hawkinsville, Georgia.

Lake Pickerel; Lake Pike;

Pickerel; general.

Pike; general.

Pond Pickerel; Lake Champlain region.

Pond Pike; New Jersey.

Red-Finned Pike; North Carolina.

Reticulated Pickerel; a book name which never gained much recognition.

Esox ohioensis

Alleghany River Pike; Alleghany River valley.

Barred Muskalonge; general. Blue Pike; Wheeling, West Virginia.

Brochet saumonne; Ohio. Chautauqua Lake Muskalonge; western New York.

Chautauqua Lake Pike; western New York.

Chautauqua Muskalonge; western New York.

Chautauqua Pike; western New York.

Jack; North Carolina. Kentucky Pike; Kentucky River valley.

Kentucky River Pike; Kentucky River valley.

Longe; general.

Lunge; general.

Mahoning Pike; western Pennsylvania.

Muskingum River Pike; southeastern Ohio.

Musky; general.

Ohio Muskalonge; general.

Ohio Pike(?).

Ohio River Pike; southern Ohio.

Picanau Blanc; Ohio.

Piccanau; Ohio.

Picareau Blanc; Missouri.

Pickerel; western New York.

Pike; Ohio River valley.

Salmon Pike; Missouri.

Wasserwolf; a name applied by O. W. Smith to all species of Muskalonge.

White Jack; Missouri.

White Pickerel; Missouri.

White Pickerel of the West; Ohio.

White Pike; Missouri.

Stizostedion

Common names of this group are so confused that no attempt has been made to

separate names belonging only to the Saugers from those belonging only to the Walleye. It is probable that practically all the names are applied to either.

Blowfish; Mississippi Valley (?)

Blue Pickerel; Ontario, Canada.

Blue Pike; general.

Brook Trout; North Carolina.

California Salmon; North Carolina.

Champlain Pike; Schroon Lake, New York.

Common Pike; Great Lakes.

Doré; Canada.

Doree; Canada.

Dory; Canada.

Glass-Eye; Great Lakes region.

Golden Perch; name given in the "American Angler," vol. 4, p. 357, apparently as a description rather than as a true name.

Golden Trout; North Carolina.

Grass Pike; Great Lakes region.

Gray Perch; Eastern Canada.

Gray Pike; New York to Ohio.

Gray Pike Perch; New York.

Green Pike; Great Lakes region.

Ground Pike; Lake Champlain.

Ground Pike Perch; Vermont.

Hornfish; Fur traders of British Columbia.

Horse-Eye Pickerel; Eastern Canada.

Horse-Fish; Great Lakes region.

Jack; Ohio Valley and western North Carolina.

Jack Salmon; Ohio valley. Ohio Pike; Ohio.

Ohio Salmon; Ohio River valley.

Okow; Cree Indians.

Perch Pike; Eastern States.

Picarel; French Canadians.

Pickerel; Eastern Canada.

Pickering; Great Lakes region.

Pike; general.

Pike Perch; Eastern States.

River Trout; North Carolina.

Rock Pike; St. Johnsbury, Vermont.

Salmon; Susquehanna River; Kentucky River; Tennessee River.

Saltwater Pike; Pasquotank River, North Carolina.

Sand Pickerel; Eastern Canada.

Sand Pike; general.

Sauger; general.

Sauger Pike;

Spike Nose; Cape Vincent; New York.

Susquehanna Salmon; Pennsylvania.

Walleye; general.

Walleyed Pike; accepted as a common name in western New York; generally common as a book name.

White Perch; Vermont.

White Salmon; Ohio Valley.

Yellow Pickerel; generally common among market fishermen.

Yellow Pike; generally common among market fishermen.

Yellow Pike Perch; New York.



EICHORNIA PAPUA. *E. papua*. Lamotte. (upper figure)
Gmelin. *E. papua*. *E. monostachya*. Gmelin (middle twenty)
Front. *E. papua*. *E. papua*. Gmelin flower (figure 1)

LIST OF COMMON NAMES WITH CROSS REFERENCES.

Allegheny River Pike <i>Esox ohioensis.</i>	Chautauqua Pike <i>Esox ohioensis.</i>
Banded Pickerel <i>Esox americanus.</i>	Chuk-Wuk <i>Esox lucius.</i>
Barred Muskalone <i>Esox immaculatus,</i> <i>Esox ohioensis.</i>	Common Eastern Pickerel <i>Esox niger.</i>
Black Pike <i>Esox niger,</i>	Common Pike <i>Esox lucius.</i> <i>Stizostedion.</i>
Black Spotted Pike <i>Esox masquinongy.</i>	Ditch Pike <i>Esox americanus.</i>
Blowfish <i>Stizostedion.</i>	Doré <i>Stizostedion.</i>
Blue Pickerel <i>Stizostedion.</i>	Doree <i>Stizostedion.</i>
Blue Pike <i>Esox masquinongy.</i> <i>Esox ohioensis,</i> <i>Stizostedion.</i>	Dory <i>Stizostedion.</i>
Brochet <i>Esox lucius.</i>	Duck-Billed Pickerel <i>Esox lucius,</i> <i>Esox niger.</i>
Brochet saumon <i>Esox ohioensis.</i>	Duck-Billed Pike <i>Esox lucius,</i> <i>Esox masquinongy.</i>
Brook Trout <i>Stizostedion.</i>	Eastern Pickerel <i>Esox niger.</i>
California Salmon <i>Stizostedion.</i>	Eithinyoo-Cannooshæoo <i>Esox lucius</i>
Canada Pike <i>Esox lucius.</i>	English Jackfish <i>Esox lucius.</i>
Chain Pickerel <i>Esox niger.</i>	English Pike <i>Esox lucius.</i>
Chain Pike <i>Esox niger.</i>	Federation Pike <i>Esox niger.</i>
Channel Pickerel <i>Esox lucius.</i>	Glass-Eye <i>Stizostedion.</i>
Champlain Pike <i>Stizostedion.</i>	Golden Trout <i>Stizostedion.</i>
Chateaugay Lake Pike <i>Esox immaculatus</i> , prob- ably a misprint for Chau- tauqua Lake Pike.	Grass Pickerel <i>Esox,</i> <i>Esox lucius.</i>
Chautauqua Lake Muskalone <i>Esox ohioensis.</i>	Grass Pike <i>Esox americanus,</i> <i>Esox lucius,</i> <i>Stizostedion.</i>
Chautauqua Lake Pike <i>Esox ohioensis.</i>	Gray Perch <i>Stizostedion.</i>
Chautauqua Muskalone <i>Esox ohioensis.</i>	Gray Pike <i>Stizostedion.</i>

Gray Pike Perch	Kinongé
<i>Stizostedion.</i>	<i>Esox masquinongy.</i>
Great Lake Pickerel	Lake Pickerel
<i>Esox lucius.</i>	<i>Esox lucius.</i>
Great Lakes Pike	<i>Esox niger(?)</i> .
<i>Esox lucius.</i>	Lake Pike
Great Northern Lake Pick-	<i>Esox lucius.</i>
erel	<i>Esox niger(?)</i> .
<i>Esox lucius.</i>	Little Pickerel
Great Northern Pickerel	<i>Esox americanus.</i>
<i>Esox lucius.</i>	Little Western Pickerel
Great Northern Pike	<i>Esox americanus.</i>
<i>Esox immaculatus,</i>	Longe
<i>Esox lucius.</i>	<i>Esox immaculatus,</i>
Great Pike	<i>Esox masquinongy,</i>
<i>Esox lucius.</i>	<i>Esox ohioensis.</i>
<i>Esox masquinongy.</i>	Long-Face
Green Pike	<i>Esox.</i>
<i>Esox niger.</i>	Long Island Pickerel
<i>Stizostedion.</i>	<i>Esox americanus.</i>
Ground Pike	Luccio
<i>Stizostedion.</i>	<i>Esox lucius.</i>
Ground Pike Perch	Luce
<i>Stizostedion.</i>	<i>Esox lucius.</i>
Hecht	Lunge
<i>Esox lucius.</i>	<i>Esox immaculatus,</i>
Hornfish	<i>Esox masquinongy,</i>
<i>Stizostedion.</i>	<i>Esox ohioensis.</i>
Horse-Eye Pickerel	Mackerel Pike
<i>Stizostedion.</i>	<i>Esox americanus.</i>
Horse Fish	Mahoning Pike
<i>Stizostedion.</i>	<i>Esox ohioensis.</i>
Hump-Back Pickerel	Marsh Pickerel
<i>Esox americanus.</i>	<i>Esox lucius.</i>
Jack	Mascallonge
<i>Esox americanus,</i>	<i>Esox immaculatus,</i>
<i>Esox lucius,</i>	<i>Esox masquinongy,</i>
<i>Esox niger,</i>	<i>Esox ohioensis.</i>
<i>Esox ohioensis,</i>	Mascalonge
<i>Stizostedion.</i>	<i>Esox immaculatus,</i>
Jackfish	<i>Esox masquinongy,</i>
<i>Esox,</i>	<i>Esox ohioensis.</i>
<i>Esox lucius,</i>	Mascalongé
<i>Esox niger.</i>	<i>Esox immaculatus,</i>
Jack Salmon	<i>Esox masquinongy,</i>
<i>Stizostedion.</i>	<i>Esox ohioensis.</i>
Kentucky River Pike	Maseanongy
<i>Esox ohioensis.</i>	<i>Esox immaculatus,</i>
Kentucky Pike	<i>Esox masquinongy,</i>
<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>

Maskalingé	Maskinongy
<i>Esox immaculatus.</i>	<i>Esox immaculatus.</i>
<i>Esox masquinongy,</i>	<i>Esox masquinongy,</i>
<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
Maskallonge	Maskinonje
<i>Esox immaculatus.</i>	<i>Esox immaculatus,</i>
<i>Esox masquinongy,</i>	<i>Esox masquinongy,</i>
<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
Maskalonge	Masquallonge
<i>Esox immaculatus.</i>	<i>Esox immaculatus,</i>
<i>Esox masquinongy,</i>	<i>Esox masquinongy,</i>
<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
Maskalongé	Masque-allongé
<i>Esox immaculatus.</i>	<i>Esox immaculatus,</i>
<i>Esox masquinongy,</i>	<i>Esox masquinongy,</i>
<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
Maskanonge	Masquenougé
<i>Esox immaculatus.</i>	<i>Esox immaculatus,</i>
<i>Esox masquinongy,</i>	<i>Esox masquinongy,</i>
<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
<i>Mas-ke-non-ge</i>	Masquinongy
<i>Esox immaculatus.</i>	<i>Esox immaculatus,</i>
<i>Esox masquinongy,</i>	<i>Esox masquinongy,</i>
<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
Maskenonza	Mountain Trout
<i>Esox immaculatus.</i>	<i>Esox americanus.</i>
<i>Esox masquinongy,</i>	
<i>Esox ohioensis.</i>	
Maskenonzay	Mud Pike
<i>Esox immaculatus.</i>	<i>Esox americanus.</i>
<i>Esox masquinongy,</i>	
<i>Esox ohioensis.</i>	
Maskenosha	Muscalinga
<i>Esox immaculatus.</i>	<i>Esox immaculatus,</i>
<i>Esox masquinongy,</i>	<i>Esox masquinongy,</i>
<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
Maskenoza	Muscallonge
<i>Esox immaculatus.</i>	<i>Esox immaculatus,</i>
<i>Esox masquinongy,</i>	<i>Esox masquinongy,</i>
<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
Maskinoje	Muscallunge
<i>Esox immaculatus.</i>	<i>Esox immaculatus,</i>
<i>Esox masquinongy,</i>	<i>Esox masquinongy,</i>
<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
Maskinonge	Muscalonge
<i>Esox immaculatus.</i>	<i>Esox immaculatus,</i>
<i>Esox masquinongy,</i>	<i>Esox masquinongy,</i>
<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
Maskinongé	Muscalunge
<i>Esox immaculatus.</i>	<i>Esox immaculatus,</i>
<i>Esox masquinongy,</i>	<i>Esox masquinongy,</i>
<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>

Muskallunge	<i>Esox macculatus,</i>	<i>Esox masquinongy,</i>
	<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
Muskalonge	<i>Esox macculatus,</i>	<i>Northern Lake Pike</i>
	<i>Esox masquinongy,</i>	<i>Esox lucius.</i>
	<i>Esox ohioensis.</i>	<i>Northern Muskalonge</i>
Muskalunge	<i>Esox macculatus,</i>	<i>Esox immaculatus.</i>
	<i>Esox masquinongy,</i>	<i>Northern Pike</i>
	<i>Esox ohioensis.</i>	<i>Esox lucius.</i>
Muskalunge	<i>Esox macculatus,</i>	<i>Noscononge</i>
	<i>Esox masquinongy,</i>	<i>Esox immaculatus,</i>
	<i>Esox ohioensis.</i>	<i>Esox masquinongy,</i>
Muskalunge	<i>Esox macculatus,</i>	<i>Esox ohioensis.</i>
	<i>Esox masquinongy,</i>	<i>Ohio Muskalonge</i>
	<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
Muskellonge	<i>Esox macculatus,</i>	<i>Ohio Pike</i>
	<i>Esox masquinongy,</i>	<i>Esox ohioensis (?),</i>
	<i>Esox ohioensis.</i>	<i>Stizostedion.</i>
Muskellunge	<i>Esox macculatus,</i>	<i>Ohio River Pike</i>
	<i>Esox masquinongy,</i>	<i>Esox ohioensis.</i>
	<i>Esox ohioensis.</i>	<i>Ohio Salmon</i>
Muskingum River Pike	<i>Esox ohioensis.</i>	<i>Stizostedion.</i>
Muskinlongé	<i>Esox macculatus,</i>	<i>Okow</i>
	<i>Esox masquinongy,</i>	<i>Stizostedion.</i>
	<i>Esox ohioensis.</i>	<i>Perch Pike</i>
Muskinongé	<i>Esox macculatus,</i>	<i>Stizostedion.</i>
	<i>Esox masquinongy,</i>	<i>Picaneau Blanc</i>
	<i>Esox ohioensis.</i>	<i>Esox ohioensis.</i>
Musk-ka-lone	<i>Esox macculatus,</i>	<i>Picareau Blanc</i>
	<i>Esox masquinongy,</i>	<i>Esox ohioensis.</i>
	<i>Esox ohioensis.</i>	<i>Pjcarel</i>
Musky	<i>Esox macculatus,</i>	<i>Stizostedion.</i>
	<i>Esox masquinongy,</i>	<i>Piccanau</i>
	<i>Esox ohioensis.</i>	<i>Esox ohioensis (?),</i>
Muskullunge	<i>Esox macculatus,</i>	<i>Esox americanus.</i>
	<i>Esox masquinongy,</i>	<i>Pickerel</i>
	<i>Esox ohioensis.</i>	<i>Esox americanus,</i>
Musquallonge	<i>Esox macculatus,</i>	<i>Esox lucius,</i>
	<i>Esox masquinongy,</i>	<i>Esox niger,</i>
	<i>Esox ohioensis.</i>	<i>Esox ohioensis,</i>
Musquellunge	<i>Esox macculatus,</i>	<i>Stizostedion.</i>
	<i>Esox masquinongy,</i>	<i>Pickering</i>
	<i>Esox ohioensis.</i>	<i>Stizostedion.</i>
	<i>Esox immaculatus,</i>	<i>Pike</i>
	<i>Esox masquinongy,</i>	<i>Esox americanus,</i>
	<i>Esox ohioensis,</i>	<i>Esox lucius,</i>
		<i>Esox masquinongy,</i>
		<i>Esox niger,</i>
		<i>Esox ohioensis,</i>
		<i>Stizostedion.</i>
		<i>Pike Perch</i>
		<i>Stizostedion.</i>

Plain Muskalone	<i>Esox immaenatus.</i>	Snake Eater	<i>Esox lacustris.</i>
Pond Pickerel	<i>Esox americanus(?)</i> , <i>Esox niger.</i>	Spike Nose	<i>Stizostedion.</i>
Pond Pike	<i>Esox americanus,</i> <i>Esox niger.</i>	Spotted Muskalone	<i>Esox masquinongy.</i>
Red-Finned Pike	<i>Esox americanus,</i> <i>Esox niger.</i>	Susquehanna Salmon	<i>Stizostedion.</i>
Reticulated Pickerel	<i>Esox niger.</i>	Tiger	<i>Esox,</i> <i>Esox immaculatus.</i>
River Trout	<i>Stizostedion.</i>	Tiger Muskalone	<i>Esox,</i> <i>Esox immaculatus.</i>
Rock Pike	<i>Stizostedion.</i>	Tiger Musky	<i>Esox immaculatus.</i>
Salmon	<i>Stizostedion.</i>	Trout Pickerel	<i>Esox americanus</i>
Salmon Pike	<i>Esox ohioensis.</i>	Troutnose Pickerel	<i>Esox americanus.</i>
Saltwater Pike	<i>Stizostedion.</i>	Unspotted Muskalone	<i>Esox immaculatus.</i>
Sand Pickerel	<i>Stizostedion.</i>	Unspotted Pike	<i>Esox immaculatus.</i>
Sand Pike	<i>Stizostedion.</i>	Varied Pickerel	<i>Esox americanus.</i>
Sauger	<i>Stizostedion.</i>	Wasserwolf	<i>Esox immaculatus,</i> <i>Esox lucius,</i> <i>Esox masquinongy,</i> <i>Esox ohioensis.</i>
Sauger Pike	<i>Stizostedion.</i>	Western Pickerel	<i>Esox americanus.</i>
Short-Billed Pike	<i>Esox americanus.</i>	Western Trout Pickerel	<i>Esox americanus.</i>
Short Pickerel	<i>Esox lucius.</i>	White Jack	<i>Esox ohioensis.</i>
Short Pike	<i>Esox lucius.</i>	White Perch	<i>Esox ohioensis.</i>
Shovelnose Pike	<i>Esox lucius.</i>	White Pickerel	<i>Esox ohioensis.</i>
Silver Pike	<i>Esox lucius.</i>	White Pickerel of the West	<i>Esox ohioensis.</i>
Slinker	<i>Esox lucius.</i>	White Pike	<i>Esox ohioensis.</i>
Smaller Pickerel	<i>Esox americanus.</i>	White Salmon	<i>Esox ohioensis.</i>
Snake	<i>Esox lacustris.</i>	Wisconsin Muskalone	<i>Licosa immaculatus.</i>

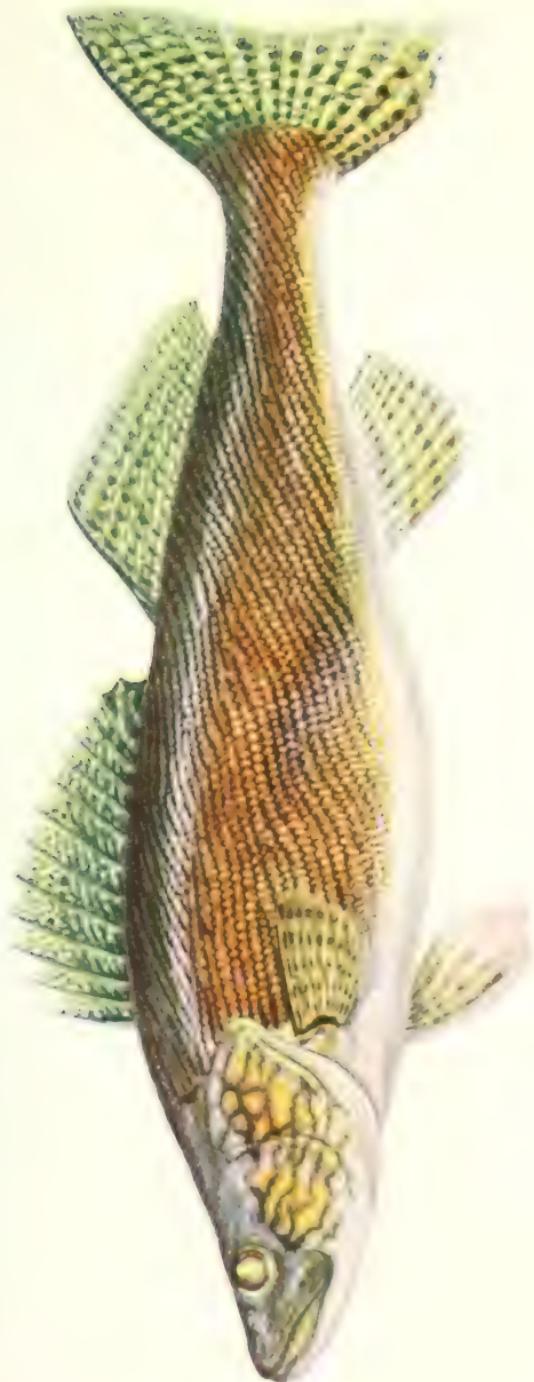
Yearling Pickerel
Esox lucius,
Esox americanus.

Yellow Pickerel
Esox niger.
Stizostedion.

Yellow Pike
Stizostedion.

Yellow Pike Perch
Stizostedion.

ALFRED C. WEED,
Assistant Curator of Fishes.



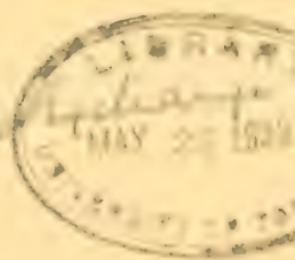
WATKINS D. FISH.
Trout, or brown trout, of Mt. Hill

THE TRUTH ABOUT SNAKE STORIES

BY

KARL P. SCHMIDT

ASSISTANT CURATOR OF REPTILES AND AMPHIBIANS



ZOOLOGY
LEAFLET 10

FIELD MUSEUM OF NATURAL HISTORY
CHICAGO, U.S.A.
1929

The Zoological Leaflets of Field Museum are devoted to brief, non-technical accounts of the history, classification, distribution and life habits of animals, with especial reference to subjects shown in the Museum's exhibits.

LIST OF ZOOLOGICAL LEAFLETS ISSUED TO DATE

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FIELD MUSEUM OF NATURAL HISTORY
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The Truth About Snake Stories

The real truth about snake stories is that they are all too likely to be untrue. The stories popularly believed about snakes are legion, and unquestionably the amount of misinformation current about them greatly exceeds what is known to the average man of the truth about snakes. "Fish stories" as a class are mere exaggerations, while reptile and snake stories are more fanciful or truly mythical elaborations of a much smaller foundation of fact. Many of the beliefs about snakes and about reptiles in general, do have some original basis in observation. When critically examined, this modicum of truth may prove to be infinitesimal, or the observable facts may prove to have been wrongly interpreted.

The tenacity of life of such misinterpretations is often extraordinary. Herodotus (Book II, section 68) relates of the crocodile that "it does not move the lower jaw, but is the only animal that brings down its upper jaw to the under one." This identical statement appears in the circular of a present day "Alligator Farm," in Florida, where it is cited as a means of distinguishing crocodiles from alligators. If one views an open-mouthed crocodile (or an alligator, for that matter) with entire oblivion to the facts of anatomy, it may indeed appear that the upper jaw is opened instead of the lower. The slightest observation, or even reflection, would prove that this is an appearance only, and that the lower jaws of crocodilians are hinged to the fixed remainder of the skull as obviously as in ourselves.

Had this story been told of snakes, it would have been partly true, for while all snakes open their lower jaws, most of them have also some power to move the tooth-bearing upper jaws. Certain salamanders have the lower jaw really fixed and open the mouth by raising the head. In the vipers, the maxillary bones are hinged to the skull and must be pushed forward to bring the poison-conducting fangs into action. This readily accessible item of information is not nearly as widely known as the wholly fabulous idea that snakes "sting with their tongues."

THE TREATMENT OF SNAKE BITE

In North America the sovereign remedy for snake bite is whisky, prescribed in large doses. A more extraordinarily wrong procedure could not well be devised. Thorough-going experiments have shown that alcohol in small doses increases the rapidity with which snake poison is absorbed by the body, while in larger doses it very rapidly becomes an active aid to the snake poison, weakening the heart action when it most requires stimulation.

The great majority of North American snakes are entirely non-poisonous. Several of the larger species, however, the common Black Snake and the large water snakes for example, are even more aggressive and more likely to bite than their poisonous brethren, a fact well known to most naturalists from personal experience. Such bites invariably heal promptly, without the slightest local or general symptoms of poisoning. To the great majority of people, however, all snakes are alike poisonous, and whisky has undoubtedly often been administered for the bite of such non-poisonous snakes. The patient, being less likely to die from the whisky alone than from the combination of whisky and snake poison, has a good chance of recovering in such cases. This chain of circum-

stances forms the foundation of the popular faith in whisky as a remedy for snake bite, though it must also be admitted that the belief is one willingly entertained by many. It is no exaggeration to say that deaths from the "remedy," when administered for the bite of really poisonous snakes, exceed the total deaths from snake poisoning in North America.

The application of scientific research, beginning with the work of Pasteur, has developed the only real specifics against snake poison in the modern anti-venins. By their use, for example, the fatalities from snake poisoning in the Brazilian state of São Paulo have been reduced from the record of 155 in 1907 to two or three in 1924. Unfortunately it has been found that specific anti-venins must be prepared for each species, or at least for each group of related species, of poisonous snakes; and this increases vastly the difficulties of treatment by this means. A North American anti-snake-bite serum has just been put on the market.

There is no reason to believe that the popular remedies for snake bite in other countries are of any greater value than the North American whisky, though probably few are so positively dangerous. The literature on this subject is an enormous one, and entirely beyond the scope of the present brief account of snake stories. The use of snakes, or parts of snakes, as *Materia Medica* is another department of snake lore which must receive mere mention.

RATTLESNAKE STORIES

The most characteristic poisonous snakes of North America are the rattlesnakes, and an extensive folklore has grown up about them. Quite the most common belief about rattlesnakes is that their age may be told by the number of rattles they possess. This is true when the rattle is complete with the original button with which the

snake was born, though the number of rattles varies with the amount of food taken by the snake, and certain other conditions, so that the average figure, three rattles per year, is subject to individual fluctuations. A rattle is added every time the skin is shed. When the snake is full grown the rattle is rarely complete.

It is widely believed that rattlesnakes when confined, and especially if tortured, will strike themselves and thus commit suicide. All available information, however, indicates that snakes are immune to their own venom, and in experiments I have made personally, causing a rattler to bite himself, there was no visible effect. There is a foundation for the story in the fact that a snake, if sufficiently excited, will lash out in every direction and may then catch his fangs on one of his coils. The Blow Snake, when going into the convulsion preceding its death-feint, frequently catches its fangs on its own body.

The common belief in the Southwest that rattlesnakes will not cross a horse-hair rope (or even a chalkline!) also seems to be without foundation.

One of the widespread beliefs about rattlesnakes in the West concerns their presence in prairie dog colonies, where they are said to live in peace with the prairie dogs and the burrowing owls. The peacefulness of this relation is certainly open to question, in view of the rattlesnake's fondness for small mammals as an article of diet.

By far the most characteristic North American rattlesnake fable is an elaboration of the fact that it is possible to be slightly poisoned by the venom in a broken fang. At its best, the story goes, a man was bitten by a rattlesnake and duly died therefrom. His infant son grows to manhood, and, finding an old pair of boots in the attic which fit him, puts them on and mysteriously dies with the symptoms of snake poisoning. An infant grandson grows up and, finding an old pair of shoes about, puts them on and becomes violently ill, but finally recovers.

Examination of the boots reveals the broken fang of a rattlesnake embedded in the leather. The number of generations in this story varies, but otherwise its general course is the same whether it is told in Florida, Texas, or California. It has recently been embodied in an excellently written short story. The amount of poison on the point of a fang is of course so small that fatal results are very unlikely.

THE JOINT SNAKE

In the Joint Snake story or the Glass Snake story, we are told of a curious snake which flies into pieces when struck with a stick. The pieces are said to reunite and crawl away if one leaves them undisturbed. This extraordinary story has a more extensive basis in fact than most of the popular snake myths. The fact that the Joint Snake is not a snake but a lizard is obscure to the ordinary observer, since it is entirely limbless and so has a snakelike form. It is, nevertheless, easily distinguished from the snakes by the presence of eyelids and ear-openings as well as by its small belly-scales and long tail. It is the length of the tail that is important to the story. Most lizards are able to lose their tails without serious injury and with the benefit that they are likely to escape while their enemies are dealing with the tail. In many lizards, among them the Joint Snake, this capacity to lose the tail is very highly developed. The tail breaks at a special breakage plane and the muscle bundles are so arranged that they expand and close the arteries, preventing the loss of blood. The tail, or the pieces of the tail, are furthermore endowed with a very active reflex motion which causes them to snap and squirm and jump so that they are very much more conspicuous than the lizard's body, which is engaged in making a quiet "get-away." It is not true that the pieces will join together again but it is some compensation for the lizard that it is able to grow a perfectly satisfactory new tail.

SNAKES CHARMING THEIR PREY

In a fanciful American Indian fable the toad saves himself from his enemy, the snake, by the clever expedient of taking a stick in his mouth and facing his pursuer. The Indians, apparently, did not have the widespread belief in the ability of snakes to charm their prey. In the full development of this belief, the snake's eyes so fascinate its bird or mammal victim that the unfortunate animal is made to advance toward the snake until it is drawn into the waiting jaws. It is possible that a small bird or mouse attacked by a snake might occasionally be unable to move from fright, but the behavior of mice when fed to caged snakes does not support even this hypothesis. Mice and rats invariably display the most complete indifference to the presence of a snake.

SNAKE CHARMING

Snakes themselves, however, may be charmed in a somewhat different sense. The professional snake-charmer, with his assistants and a stock of snakes, is a familiar figure throughout the Orient. Quite the most mysterious element in this so-called snake-charming lies in the apparent response of the snakes to music. "Deaf as an adder" is an old English adage, and the deafness of snakes in general seems to be supported by the most careful scientific experiment. In most cases, the swaying of the snakes in time to the music is due to the swaying of the body of the performer, and stops when he comes to rest. The snakes used in this practice are usually poisonous species, and the favorites are the cobras, which are preferred for their spectacular hood, their habit of raising the head and body, and their connection with Hindu mythology. Sometimes these poisonous snakes are defanged, sometimes their lips are sewed shut, and sometimes they are certainly *not* so treated, but remain in full possession of their poison apparatus. It is likely

that some of the professional snake-charmers are immune to the poison because of repeated small inoculations. An adequate study of Oriental snake-charming from the scientist's standpoint remains to be made.

It is interesting that the removal of the poison fangs does not make a poisonous snake permanently harmless. The teeth of snakes are shed and replaced throughout life, and the poison fangs are simply teeth modified into hypodermic needles for the injection of poison.

VIVIPAROUS AND EGG-LAYING SNAKES

Most reptiles lay eggs, but it is a curious and popularly much misunderstood fact that many snakes give birth to living young. In the reptile egg the growing embryo is nourished by a large food yolk. When the eggs are retained in the mother snake's body, development takes place and eggs may be laid with embryos at various stages of advancement. In many snakes the development of the eggs in the body until the young snakes are fully formed has become the rule, and the young are then born alive. Since the young are nourished from an egg-yolk and not from the blood of the mother, this form of development is distinguished as ovo-viviparity. In the Chicago area the commonest species of snakes, the Garter Snake and Water Snake, with their small allies, produce living young. This is also the habit of the only poisonous snake found near Chicago, the Prairie Rattlesnake or Massasauga. The egg-laying species are the Green Snake, Blue Racer, Milk Snake, Spotted Adder (or Fox Snake), and the Hog Nosed Snake. The eggs of snakes may usually be recognized by their elongate shape and leathery shell.

THE FEAR OF SNAKES

It is a widely held belief that the common aversion to snakes which amounts to violent fear in many persons, is instinctive in the human race. The evidence at my

disposal leads me to the conclusion that this aversion and fear, when they exist, are wholly due to the example of an older person. I have never found any child who exhibited the slightest fear of snakes if he had not previously been frightened about them. On the average, in support of this observation, I find the fear of snakes much more frequent in older than in younger children. Anthropoid apes and, indeed, most monkeys, exhibit the same fear of snakes as is shown by man, but evidence exists to indicate that their fear is no more instinctive than the human. Drs. Mitchell and Pocock, of the London Zoological Society, experimented with the animals kept in the Zoological Gardens, and found that the great majority of the monkeys exhibited pronounced fear of harmless snakes which were shown to them. The behavior of the monkeys stood in marked contrast to that of all other mammals, including the lemurs (relatives of the monkeys), which were either indifferent to the presence of snakes or were merely curious about them. Some years later, remembering that a young chimpanzee had shown no fear, the experiment was repeated by offering a harmless boa to a chimpanzee which had been received at the society's Gardens at a very early age. This youngster was not in the least afraid of the snake and, on the contrary, came to regard snakes as interesting playthings. Thus the "instinctive" fear of snakes in monkeys appears to be based on the example of frightened adults exactly as it is in children.

THE BLOW SNAKE

Throughout eastern North America a snake is found which usually bears a most evil reputation. The number of popular names applied to it attest its abundance, and many of them indicate its bad character. It is known variously as "Hog Nosed Snake," "Spreading Adder," "Blow Snake," "Blowing Viper," and "Puff Adder." Terrifying tales are told of the way in which this snake

actually blows its venom from a considerable distance into its victim's face, causing sometimes temporary blindness, sometimes convulsions. Although most of these stories are told at second hand, there is no dearth of actual eye-witness evidence of such poisonings.

As this snake is a common one in all sandy localities, there is no difficulty in checking up this reputation with actual observation of its behavior. In this case the facts turn out to be far more remarkable than the beliefs. As "Hog Nosed Snake" suggests, this species has a triangular, flattened head, with a sharp-pointed and slightly up-turned snout. The shape of its head corresponds well with the rough diagnosis of poisonous snakes as "broad-headed." In fact, when the Spreading Adder spreads the bones of its jaws at the rear of the head, as it does when alarmed, the head is proportionately broader than that of any rattlesnake. In addition to flattening and widening the head, the whole anterior third of the body is strongly flattened, and raised from the ground. In this position the snake faces its enemy, a more formidable-looking animal than an Indian cobra of equal size. The lungs are filled with air, the middle of the body becoming twice its normal size, and if the intruder approaches the snake it strikes and lunges viciously at him with open mouth and with loud hissing exhalations of the breath. In every action it is more aggressive and more dangerous in appearance than any poisonous snake of similar proportions.

However, this snake has apparently been infected with the "Great American Bluff." If one refuses to be frightened by this performance, advances upon the threatening reptile, and holds a finger within reach of its stroke —*it does not bite*. The stories about the poisonous nature of its breath are evidently fictitious, for no effect on nose or eyes can be observed. If picked up, however, the nauseous secretion of the anal scent glands is emitted,

and to an already frightened person this odor might suggest a poisonous breath. Detailed examination of the anatomy of this snake, as well as direct observation, proves that it is entirely harmless.

If a snake of this species is still further molested, and especially if it is actually hurt, it gives up the whole repertoire of bluff and tries another dodge, the well-known one of "playing 'possum." This it does with variations of its own. It writhes and squirms convulsively, opens its mouth, lets the tongue hang out, turns on its back, and ceases to move. It may now be poked or moved about, and is apparently a dead snake. In its reptilian mind, death and lying on one's back are evidently synonymous, for if one turns the snake over on its belly, it instantly turns back again to lie on its back, as if to demonstrate before one's eyes that it is veritably dead. If one sits still and watches, after a few minutes the snake's head will be raised to see if the coast is clear, and if no move is made, it rights itself and at once attempts to escape. If the observer makes a move, the attitude of death is promptly resumed.

That this behavior may successfully delude a competent observer is seen in the account of this reptile by J. H. Hinton (*History and Topography of the United States*, London, 2, p. 185, 1832). "The brown viper or hissing snake is of a dirty brown color, from six to eight inches long, with a body large in proportion and terminating abruptly in a sharp tail: when angry their heads flatten and dilate to twice the common extent, and their hiss is like that of a goose. They are extremely ugly animals: and though very diminutive, are supposed to be of the most venomous class. One being confined with a stick across its back, it instantly bit itself in two or three places; and when set at liberty it soon became very much swollen, and died."

The Blow Snake stories are fables in eastern North America, but in Africa similar stories about really poison-

ous snakes are perfectly true. One of the African cobras, a common species in northeast Africa, spits its poison with evident aim at the face of an approaching enemy, and this poison causes violent inflammation of the eyes if it reaches them. A near relative of the cobras, the Ringhals or Spuyslang of South Africa is an even more inveterate spitter, and captive specimens have been known to keep the glass fronts of their cages sprayed with poison.

THE HOOP SNAKE

Another cycle of snake myths peculiar to North America relates to the Hoop Snake. The various Hoop Snake stories are told with so much gusto, and are embroidered with such incredible details that they seem more like "tall stories" designed for the edification of the tenderfoot than like genuine beliefs, held by otherwise sane persons.

The best-known version of this story tells of a large snake that progresses by taking its tail in its mouth and rolling like a hoop. The tail is said to be provided with a venomous sting, and the snake is capable of launching itself like a javelin, tail foremost, at an enemy. A wound by the tail-sting is almost instantly fatal, and the poison is so virulent that trees, accidentally struck by this snake, immediately wither and die. The force of its blow is such that a snake of this species has been known to strike its tail so violently into a tree as to be unable to disengage itself.

The background for this terrifying story is found in the much more widely held belief in a snake that stings with its tail, usually referred to as the "Stingin' Snake" or "Horn Snake." This, in turn, is based on the behavior of certain snakes when held in the hand or even when confined with a stick, which make exploring or apparently pricking movements with the tip of the tail. When, in addition, the tail ends in a sharp horny spine, some excuse is afforded for the belief in a tail-sting. The

truth is, however, that no matter how much the tail of a snake may appear like a sting or even act like a sting, no snake has a poisonous or dangerous weapon in its tail. This fact is of course easily demonstrated by a person who happens not to fear harmless snakes, but such a person will frequently be taxed with the possession of occult or special powers which render him immune. The elaborations of stories of a stinging snake into accounts of a snake that rolls like a hoop are of course entirely fabulous.

THE MILK SNAKE

Two snake myths are apparently quite universal, the one to the effect that snakes, frequently some particular species of snake, suck milk from cows, and the even more startling belief that young snakes take refuge in their mother's throat when alarmed or in danger. Both of these stories are supported by an enormous mass of evidence from eye-witnesses. The two stories represent very different types of myths, the first being physically impossible, while the second is at least not impossible.

It is not difficult to establish a hypothesis for the origin of the Milk Snake story. Cows are liable to sudden variations in milk flow from a large number of natural causes. This variation is a subject of importance to the cow's owner and a matter of frequent observation, while the true causes of the failure of the milk flow are often obscure and rarely observable. With this mental background, if a species of snake were found to frequent barns or pastures; and if an individual snake were to be seen to drink milk from the cat's saucer, or to drink the milk leaking from a cow's distended udder, a causal connection between the presence of the snakes and the fluctuations in milk flow might be suspected. The snake most often credited with this performance, and known, in fact, as the Milk Snake (*Lampropeltis triangulum*) in eastern North America, fulfills the requirement of

frequenting barns; and, as snakes all drink water, it is not at all unlikely that they would drink milk on occasion. For that matter the country people in India are said to set out a saucer of milk for the cobra which frequents their premises.

It has been suggested that some of the egg-laying snakes frequent manure piles and compost heaps about barns for the purpose of laying their eggs. Most farmers, when they kill a snake, do so with such blind zeal and fury that little of the victim is left. The crushed eggs of a gravid snake would give forth a milk-like fluid, and this might be observed as confirmatory evidence for the belief in their ability to suck cows.

The ability of any snake to fasten itself to a cow's udder and suck milk must be considered a plain impossibility. If the six rows of needlelike recurved teeth in a snake's mouth were applied to a cow's sensitive teat, the animal would be driven into a frenzy, and the snake would be promptly dislodged by being stepped upon or kicked.

The Milk Snake frequents barns for the mice which are its favorite prey. It is one of the most gentle and useful of all North American snakes. Its bite, if it could be induced to bite, would be absolutely harmless, no more dangerous than a few pricks or scratches from sterile needles, and not a fraction as dangerous as the bite of a mouse or rat. In western North America, the abundant gopher snakes (*Pituophis* spp.) are taxed with sucking cows. In other lands, other species of snakes are singled out as "carriers" for the myth. A singular variant appears in Brazil, where certain snakes are thought to frequent the huts of the Indians at night for the milk of the human mothers.

MOTHER SNAKE SWALLOWING YOUNG

The attractive story that the mother snake receives her young into her throat to protect them from danger

is apparently not physically impossible. The "snake-swallowing-young" story is supported by such plausible published accounts, some of them apparently so credible, that even reputable herpetologists maintain, or endeavor to maintain, an open mind on this particular question. It has been objected that the young would immediately suffocate, or that they would be attacked by the gastric juices; but snakes do not suffocate very promptly, and there is a goodly stretch of gullet before the snake's stomach begins.

A second line of attack on the validity of this story rests on the possibility of a misinterpretation of perfectly correct, though hurried, observation. Many species of snakes, and among them the very ones to which the story is most frequently attached, give birth to living young. For several days before their actual birth these snakes are fully formed and capable of motion. As I have indicated above, snakes are commonly killed with brutal violence, and a gravid viper or garter snake or rattle-snake might then be seen to contain actual living young. No ordinary person takes the trouble to distinguish between one internal organ and another, in a snake at least, and an observer of the facts outlined above, especially if already familiar with the "snake-swallowing-young" story, would doubtless become an active witness for the truth of the belief.

Miss Joan B. Procter, of the London Zoological Society, suggests another bit of observation which might be misinterpreted. The common English snakes frequently feed on lizards, and the tails of their prey would be seen to wriggle as they disappeared down the snake's throat. Numerous snakes are snake-eaters, and on some occasions such snakes might be found to contain one or more other snakes when killed.

The most conclusive objection to the truth of the story is that the occurrence has never been observed in

the London or New York Zoological Gardens, where thousands of snakes have been kept alive, and where hundreds of broods of young snakes must have been born. In captivity, such young snakes would be confined to the box with their mother, while in nature there is no evidence independent of the stories in question to show that the young snakes remain with their parent at all. *A priori* the story seems improbable. It bears all of the ear-marks of a "snake story," even to the abundance of eye-witness evidence. Altogether, it is overwhelmingly improbable.

Against this improbability must be set the frequently detailed accounts of numerous observers, among whom are men of education and even a few scientists, and the vast popular conviction that the story is true. No story is more universally known. Milton's guardian of the gates of Hell seems evidently based upon it or upon some classical version which would carry the story still farther back in time.

I can do no better than to quote the most convincing of the accounts known to me (E. D. Ball, Proceedings of Iowa Academy of Science, 22, pp. 343-344), and leave the reader with the hope that so charming a story may yet be proved true, to the confusion of skeptics and unbelievers.

"The country school in Iowa which the writer attended was held in the ordinary frame schoolhouse supported by a 'cobblestone' foundation of water-worn rocks more or less embedded in mortar. The schoolhouse faced the south and a set of narrow steps led up to the single central door. Through the foundation wall about halfway between these steps and the southeast corner of the building, and about eight to ten inches above the surface of the ground, was an irregular opening about two inches in diameter. This opening was used as a refuge one spring and summer by a large and motherly looking specimen of the common Garter Snake of the region.

The snake kept close to the hole at first and disappeared at the slightest sound. Later as we became interested in it, it was not disturbed and became accustomed to the ordinary noises of the children and would, if not too closely approached, often lie in the sun alongside the wall during recess time. One day as we came trooping out at noon the snake raised its head several inches from the ground, uttered a hissing sound and then lowered its head to within an inch or two of the ground and opened its mouth quite widely. This rather frightened us and all eyes were on the snake, when from around the corner of the house and from further away in the yard came a number of small snakes which rushed pell-mell into the open mouth of the mother. When the last one was in, the mother snake raised her head quite high, wriggled over to the hole and disappeared. She was back there again at the next recess and the performance was repeated for a number of days. After this the same thing occurred at each recess, and two of us, who had even then budding naturalistic instincts, would occasionally ask to go out in order to get a performance for our special benefit.

"When the troops of children were pushing and elbowing to see, they would crowd up within a few feet of the snake, and the performance was very hasty and the snakes' disappearance rapid—the whole occupying only a few seconds. When, however, we went out alone and were careful not to get too near at the start, the mother snake would often not go into the hole at first but simply raise her head and remain in that position for several minutes, or until our curiosity prompted us to approach too close, when she would go in rather leisurely.

"At these times the first little snakes to enter the mouth would almost instantly turn around and stick their little heads out and thrust out their forked tongues as defiantly as you please. Often there would be three or four of these heads sticking out at one time, and considerable signs of a rumpus going on inside her body a

few inches back from the head. These signs we interpreted as the other little snakes fighting for a chance to get their heads out.

"The little ones never seemed to be far away and often would be lying alongside the mother. The hiss seemed to be the sign for them to scurry for the mouth, and often two or three would be entering at the same time, while frequently before the last one was in there would be one or more heads sticking out. We never saw a little snake come entirely out, for as soon as the last one started in the mother snake would raise her head quite high, higher than that species ordinarily carries its head. The bulge in the mother snake was always in that part above ground, and there was always considerable movement in the bulge.

"There could be no possibility of an optical illusion through the small snakes' going under the mother, because as soon as they were in, the head was always raised higher than the length of the little snakes, and their heads and often an inch of their bodies would be showing out of the mouth at this time. Moreover the hole the mother's body went through was a tight fit around the bulge so that no little snakes could have gone in outside the mother, even if they could have reached up to the hole, which they could not. And if they were going into the hole at all why go past it as they often did to reach the mother's mouth? This same performance has been witnessed several times since under less satisfactory conditions, but at the time no question had been raised in the writer's mind and no particular attention was paid the details."

As Dr. Ball is one of the leading entomologists of the United States, his account of this phenomenon is evidently not only the most interesting but one of the most convincing. But for his last sentence, and the fact that the story is told as a memory of an event many

years past, it could be accepted as the conclusive proof for which students of reptiles must still wait.

In the face of accounts so plausible and so detailed, "rationalistic" explanations of the supposed observations are evidently worthless. Snake stories of this type are true myths, all the more interesting because they are alive and growing, and herpetologists may resign the study of this field to their anthropological brethren with the hope that it may produce valuable insights into the nature of mythology and folklore.

KARL P. SCHMIDT

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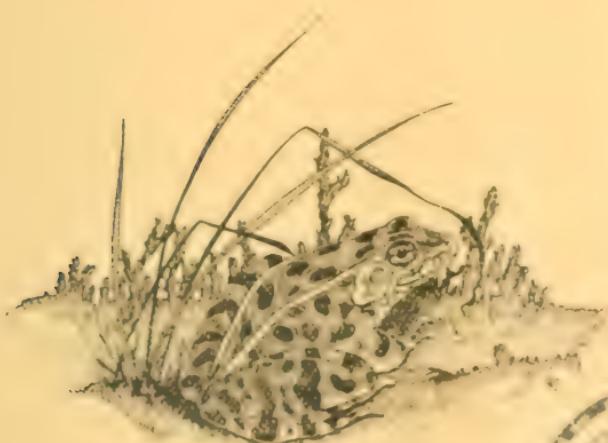
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THE FROGS AND TOADS OF THE CHICAGO AREA

BY

KARL P. SCHMIDT

ASSISTANT CURATOR OF REPTILES AND AMPHIBIANS



ZOOLOGY
LEAFLET 11

FIELD MUSEUM OF NATURAL HISTORY
CHICAGO

The Zoological Leaflets of Field Museum are devoted to brief, non-technical accounts of the history, classification, distribution and life habits of animals, with especial reference to subjects shown in the Museum's exhibits.

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STEPHEN C. SIMMS DIRECTOR

FIELD MUSEUM OF NATURAL HISTORY
CHICAGO, U.S.A.



COLOR CHANGE IN THE COMMON TREE-FROG

Drawn from a single specimen.

FIELD MUSEUM OF NATURAL HISTORY

DEPARTMENT OF ZOOLOGY

CHICAGO, ILL.

LEAFLET NUMBER 11

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Frogs and Toads of the Chicago Area

The "Chicago Area" may be defined as the area within fifty miles of the center of the city of Chicago. It includes a small corner of southeastern Wisconsin, larger sections of northeastern Illinois and northwestern Indiana, and a small segment of southwestern Michigan. The present account of the frogs and toads of this region forms one of a series of leaflets designed as introductions to the study of the local animals. It is hoped that resident naturalists will find them a useful basis for the much-needed detailed studies which still remain to be made.

In all of North America north of Mexico there are seventy-two different kinds (or species) of frogs and toads. Only eleven of these are found in the vicinity of Chicago. Of these eleven, two are true toads, five are true frogs, and the remaining four are tree frogs, or tree toads. It is a curious fact that there is no comprehensive English word which includes the frogs and toads and their allies, corresponding with the zoological group "Salientia." Salientia means leapers, which certainly indicates one of their most distinctive characters. The *order* Salientia, in turn, forms one of the subdivisions of the *class* Amphibia, which as a whole is intermediate between the fishes on one hand and the reptiles on the other. The body form of the frogs and toads, without a tail and with long hind limbs adapted for jumping or hopping, distinguishes them at a glance from their nearest relatives,

the salamanders (order Caudata). The living amphibians include a third order, the caecilians (order Apoda), which are limbless, wormlike, burrowing forms entirely confined to the tropics.

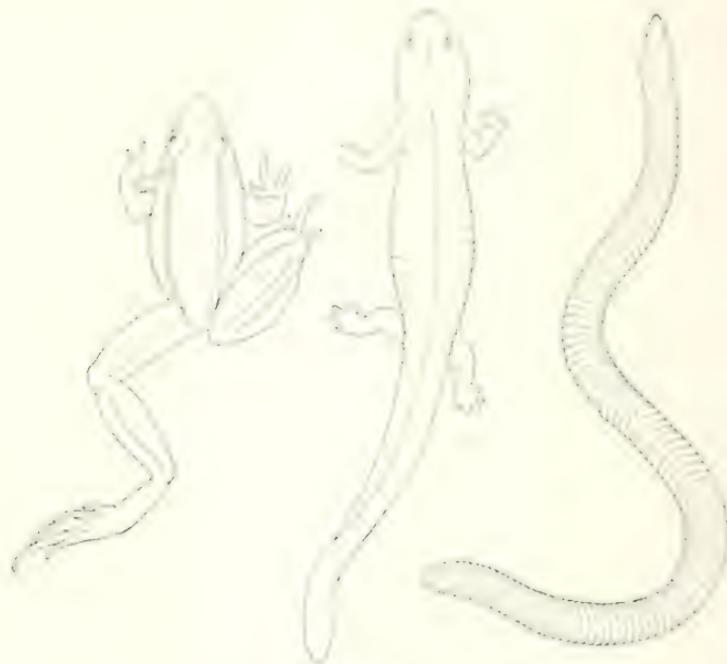


FIG. 1

A frog, a salamander, and a caecilian, illustrating the three orders of amphibians.

Unlike the reptiles, which are primarily land animals, the great majority of amphibians begin life with an aquatic stage, as tadpoles or larvae. All of the local species of frogs and toads deposit their eggs in water, and the young develop an aquatic tailed tadpole. They grow as tadpoles until they are ready to transform into the tailless land stage.

For a short time after hatching, the tailed and limbless larvae have branched external gills. They attach themselves to the jelly mass which enclosed their eggs, or to the surrounding vegetation, by means of a pair of suckers.

As the mouth develops its characteristic horny beak, the suckers are lost, and at the same time a fold of skin grows backward from the head and encloses the gills. Under this fold of skin the front limbs develop, and do not appear externally until they are fully formed and until the hind limbs are well advanced. The name tadpole should really be restricted to the period between the development of the gill pouch and the appearance of the front limbs. The rounded, limbless and gill-less fore part of the body distinguishes the frog tadpole from the early stages of the salamanders, which may be called larvae throughout their period of development.



FIG. 2

A frog tadpole and a salamander larva.

The changes that take place at the time of transformation of the tadpole into the adult land stage are remarkable. The horny 'teeth' are lost and the true jaws and mouth developed; the tail is lost; the gills are lost; and most remarkable of all, the long coiled intestine of the plant-eating tadpole shrinks to a fourth of its length in the insectivorous adult frog.

Most adult amphibians require a considerable degree of moisture in their surroundings, and die at once in dry situations. The toads form a partial exception to this rule, and their horny and warty skin is an adaptation to decrease evaporation in the drier situations in which they live. The primary characteristic that marks the 'salientian' is the curious body form, which is especially adapted for a leaping mode of locomotion. The leaping powers are reduced in our toads, which have taken up a more or less subterranean existence. The more terrestrial true frogs are also good swimmers, and among them the

highest development of the webbed hind foot is found in the Green Frog and Bullfrog, the forms most closely confined to the water. The tree frogs represent an adaptation of the frog form for life in trees and bushes. They are enabled to climb by adhesive disks on the tips of their fingers and toes. These three groups—the toads, true frogs, and tree frogs—represent three of the nine existing families of frogs and toads.

There are eleven kinds of frogs, toads, and tree frogs common in the Chicago area, i.e. within fifty miles of the center of the city. Their names are:

THE TOAD FAMILY (*Bufo*idae)

1. Common Toad (*Bufo americanus*)
2. Fowler's Toad (*Bufo fowleri*)

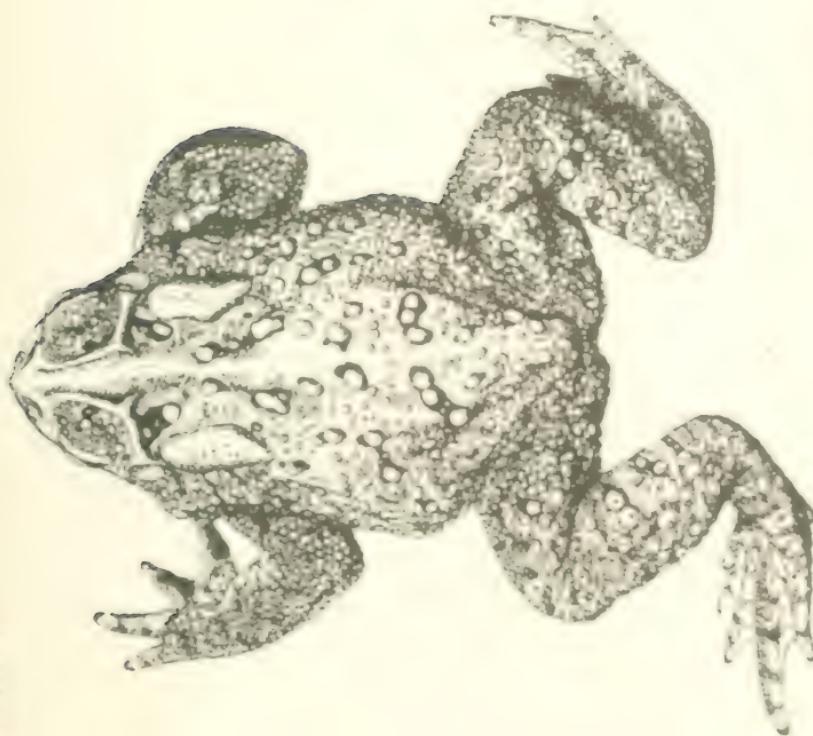
THE TREE FROG FAMILY (*Hylidae*)

3. Common Tree Frog (*Hyla versicolor*)
4. Spring Peeper (*Hyla crucifer*)
5. Swamp Tree Frog (*Pseudacris triseriatus*)
6. Cricket Frog (*Acris gryllus*)

THE TRUE FROGS (*Ranidae*)

7. Leopard Frog (*Rana pipiens*)
8. Pickerel Frog (*Rana palustris*)
9. Wood Frog (*Rana cantabrigensis*)
10. Green Frog (*Rana clamitans*)
11. Bullfrog (*Rana catesbeiana*)

Besides these, there are old records of the occurrence of the Crayfish Frog (*Rana areolata*) in northern Illinois and Indiana, and there is a possibility that the southern form of the leopard frog (*Rana sphenocephala*) reaches the southwestern border of our area. The common forms may be distinguished by means of the figures in this leaflet, any doubtful cases being checked with the de-



scriptions of the individual forms. These figures, together with the color plate illustrating color change in the common tree frog, are the work of Mr. L. L. Pray, of the taxidermy staff of Field Museum of Natural History. The figures have been grouped to show the related forms together for comparison; the toad family in plate II, the tree-frog family in plate III, and the true frog family in plate IV.

The flash-light photograph of the Swamp Tree Frog singing with its throat fully distended (plate V) was taken by Mr. C. J. Albrecht, also of Field Museum's taxidermy staff. It is unusual in showing the approach of the female to the calling male, (compare Overton in bibliography at end).

KEY TO THE FROGS AND TOADS OF THE CHICAGO AREA

- A. Skin very rough or 'warty,' with a pair of oblong swollen glands on the shoulders; head with bony ridges. (Family Bufonidae), plate II.
- B. Dark spots on back usually enclosing a single wart; crosswise bony ridges behind the eyes connected with the shoulder glands by short backward spurs.

Common Toad (*Bufo americanus*)

- BB. Dark spots on back usually enclosing three or more warts; crosswise ridges touching the front edges of the glands.

Fowler's Toad (*Bufo fowleri*)

- AA. Skin smooth or nearly so; no special glands on the shoulders; head without bony ridges.
- B. Tips of fingers and toes with expanded adhesive disks. (The disks are small in two forms and careful attention is required to distinguish them). (Family Hylidae), plate III.

C. Finger disks about twice as wide as the finger.

D. Size small, color brownish, a dark X on the back.

Spring Peeper (*Hyla crucifer*).

DD. Size moderate, color green or gray with darker markings; a white mark below the eye.

Common Tree Frog (*Hyla versicolor*).

CC. Disks of fingers no wider than the finger itself; size very small.

D. Toes without webs; three dark brown stripes down the back.

Swamp Tree Frog (*Pseudacris triseriatus*).

DD. Toes with well-developed webs; a triangular dark mark between the eyes.

Cricket Frog (*Acris gryllus*).

BB. Tips of fingers and toes pointed, without trace of disks. (Family Ranidae), plate IV.

C. No raised glandular fold along the sides of the back.

Bullfrog (*Rana catesbeiana*).

CC. A pair of glandular folds from behind the eyes along each side of the back.

D. Large dark spots on the back.

E. Spots rounded, thighs not yellow.

Leopard Frog (*Rana pipiens*).

EE. Spots squarish, thighs yellow or orange on concealed surfaces.

Pickered Frog (*Rana palustris*).



THE FROGS OF THE GORDON AREA

- a. The Common Tree Frog. b. The Spring Peeper. c. The Swamp Tree Frog.
d. The Cricket Frog.

DD. Back without large spots.

E. Color green; no black on cheeks.

Green Frog (*Rana clamitans*)

EE. Color brown; cheeks black.

Wood Frog (*Rana sylvatica*)

COMMON TOAD (*Bufo americanus*)

Everywhere in North America, as well as in Europe and Asia, there is a toad which is referred to as "the common toad." The Common Toad of the Chicago area belongs to a species which ranges from Labrador to Minnesota and south as far as Missouri and North Carolina.

This toad is a useful animal, at home in gardens and cultivated fields, where it feeds on the most abundant insects, which, in these situations, are likely to be pests. It is an ugly creature in common parlance, but to anyone who views its gravely comical behavior in a friendly spirit the word "ugly" seems singularly out of place.

In the spring the toad migrates from its hibernation quarters to a nearby pond or marsh. Here the males set up a chorus whose high-pitched musical trill can be heard to great distances (probably at least a mile). Mating usually takes place promptly and the chorus is over after a few nights. The eggs are laid in cylindrical strings of gelatin, a character which distinguishes them sharply from the eggs of the frogs and tree frogs. The development of the young is rapid and the tadpoles transform into tiny black toadlets averaging only two-fifths of an inch in length, leaving the water within about two months of the date of egg-laying.

The common belief that the handling of toads may cause warts is wholly without foundation. It has evidently arisen from the simple analogy between the wart-

of toads and the existence of warts on the hands of small boys. The 'warts' of the toad's skin of course bear no relation to the warts to which the human skin is subject. The skin of toads does secrete a poison, which is a violent irritant to the mouth and eyes, but not to the skin of man. This poison probably protects the toad from some of its enemies. Dogs, at any rate, usually learn to leave them alone after a single trial. Some snakes, unfortunately, are immune to the toad-poison, and are the worst enemies of this harmless and useful animal.

A second widespread belief about toads is that they are found living imprisoned in solid wood or rock. This belief seems to be founded on actual finds of toads in curious situations. The toad's habit of backing down crevices, especially to hibernate, seems adequate to account for the reports of imprisoned toads. A small toad spent the winter in a crevice between the concrete floor and stone wall of the basement of the writer's house some years ago. Toads have a horny tubercle at the heel by means of which they burrow into the ground. The body moves backward as the limbs push the dirt out of the way.

FOWLER'S TOAD (*Bufo fowleri*)

The occurrence of a second species of toad in eastern North America, sometimes in the same localities with the Common Toad, has been an interesting subject of discussion in museum circles since 1907, the time of publication of Miss Dickerson's *Frog Book*. Little by little naturalists have learned to distinguish this form from the common one, though occasional specimens seem to be really intermediate. The two were long confused, and it has only lately become evident that the second species is really more widely distributed than the first.

Fowler's Toad in this locality can usually be recognized by its paler color; having the dark spots on the back

larger and the warts smaller, usually with three or four warts in a single spot; and by the fact that the large gland on the shoulder (the parotid gland) touches the crosswise bony crests behind the eyes.

Its distribution is strikingly different from that of the Common Toad. It is rather strictly confined to sandy areas in the Chicago region. It is the abundant toad of the Indiana dunes, and occurs again at Beach, north of Waukegan. There is no doubt that it ranges into Wisconsin along the shore of Lake Michigan, though it has not yet been recorded from that state.

The Fowler's Toads come out of hibernation much later, and lay their eggs much later, than do the common toads. One of the most striking differences between the two species lies in their voices. While that of the Common Toad is high-pitched and musical, the note of Fowler's Toad is nasal, and lower in pitch. Like the voice of the Common Toad, it carries well and may be heard at a considerable distance.

COMMON TREE FROG (*Hyla versicolor*)

The largest tree frog in the Chicago Area is a green or gray stout-bodied frog of moderate size. It is a typical member of the tree frog family in having well-developed disks on the tips of both fingers and toes, by means of which it clings to tree trunks, water plants, or even to the glass walls of a terrarium. It is distinguished by color and size from the only other true *Hyla* in this area, and the dark markings on its back are rarely as regular as are those of the spring peeper.

This species is capable of remarkable color change. A few of the color phases of a single individual are represented in plate 1, and another plate illustrating color change in this species may be found in Miss Dickerson's *Frog Book*. Most of the color phases are direct responses to the environment and illustrate an exceptionally

perfect 'concealing coloration.' A curiously constant character of this species is the white marking beneath the eye, which persists through all the color changes of which this species is capable; another constant and distinctive character is the bright orange marked with black of the posterior surfaces of the thighs.

The Common Tree Frog is still found in wooded places around Chicago. Specimens in the museum collection come from northern Indiana, Highland Park, and even from Jackson Park, in the city. Its voice is a pleasing rattled trill, often heard before or at the beginning of a rain.

SPRING PEEPER (*Hyla crucifer*)

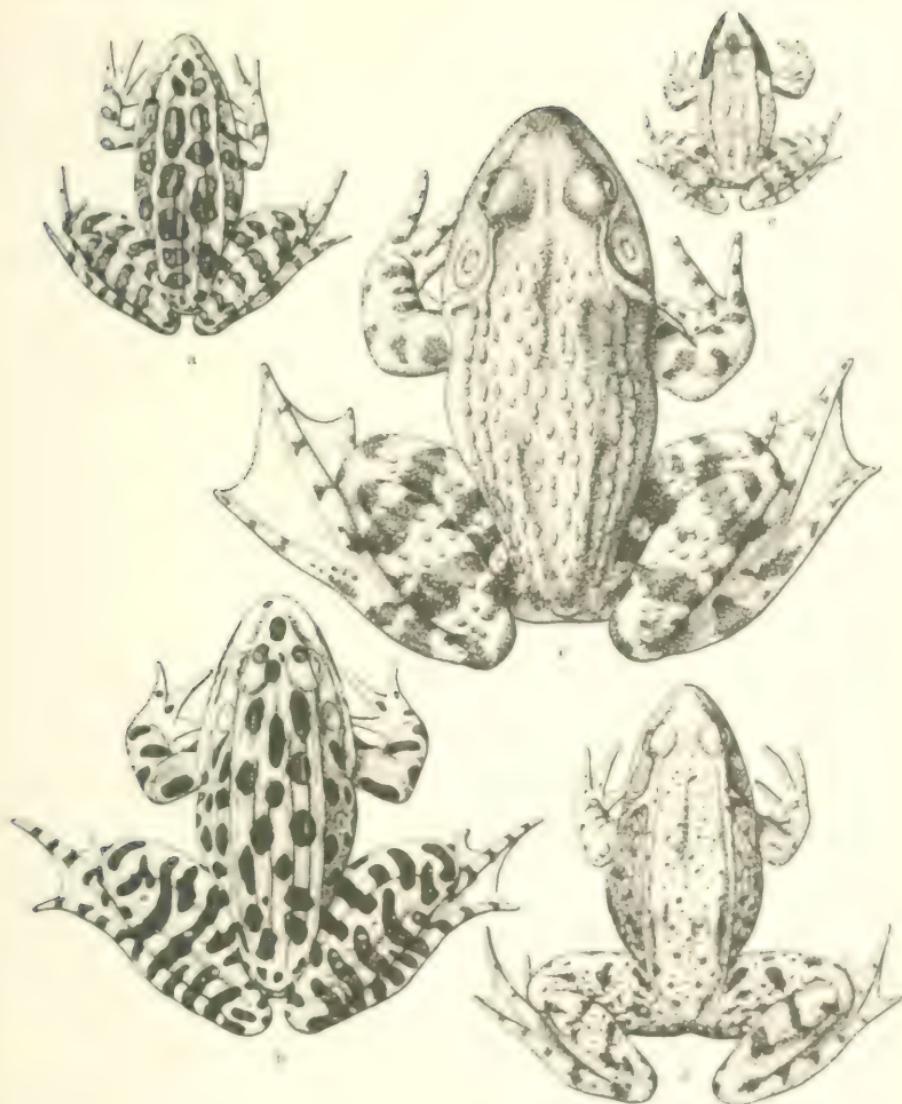
The Spring Peeper is abundant in the Dune Region of northern Indiana, and has been recorded from Beach, north of Waukegan. Its voice has been heard at Homewood, to the southeast of Chicago, but it seems to be absent at Morgan Park.

This tiny frog is one of the earliest species to appear in the spring, and its shrill and clear whistle, often composed of two notes slightly different in pitch, is one of the most pleasing of the night sounds that go to make up the season's frog chorus.

The Spring Peeper is easily recognized by its small size and brownish color, with a more or less regular X-like dark marking on the back. It is of about the same size as the next species in the list, but never has dark lengthwise stripes. The disks of its fingers and toes are well developed.

SWAMP TREE FROG (*Pseudacris triseriatus*)

Wherever a bit of cat-tail marsh persists within the limits of Chicago, the tiny brown striped Swamp Tree Frog is likely to be found. Its voice is the first to be heard in



TRUE FROGS OF THE CHICAGO AREA

- a. The Pickerel Frog. b. The Leopard Frog. c. The Wood Frog. d. Dusky Frog.
e. The Bullfrog.

the spring, and when a chorus sings together the sound carries to a great distance. Although everyone has heard this froglet, few have seen it, for it is shy in the daytime and refuses to sing when anyone approaches. At night, with an electric flash-light, it is easy to find the songster. The voice of *Pseudacris* is a rattling croak, more like that of a wooden 'tick-tack' than any other familiar sound, and not at all easy to imitate. It is this frog's croaking which is most widely recognized as proceeding from a frog; but most people who hear it probably associate it with one of the larger common frogs, and would be astonished if they could see what a tiny and peculiar tree frog it is.

"Swamp Tree Frog" seems to be a contradictory name, but it is really a very appropriate one. This group of frogs belongs to the great tree-frog family, but has modified its habits, and taken up residence in the swamps and meadows. The disks of its fingers are less developed than are those of the really tree-climbing tree frogs. As it is the only frog in our area with lengthwise brown stripes, it is easily recognized.

CRICKET FROG (*Acris gryllus*)

This little frog is well named, for both its voice and its sudden leaps are cricket-like. It is easily recognized by the constant presence of a triangular marking between the eyes, with the point directed backward, while other features of the coloration are very variable. Although not as rough as the toad's skin, the Cricket Frog's skin is raised into low rounded warts, and this, together with its color pattern, its very long hind legs, and its fully webbed toes, distinguishes it from other Chicago frogs. It is of about the same size as the Swamp Tree Frog and the Spring Peeker.

The Cricket Frog comes out of its hibernating places in the mud, as soon as the ice is off the ponds, and often as soon as there is a little open water at the edge of the ice.

It does not begin to sing however, until the beginning of warm weather, and its rapid croak (like cracking two small stones together under water) does not begin until later in the season. Its voice does not carry far and it is necessary to visit the ponds in order to hear it well.

Like the Swamp Tree Frog, the Cricket Frog is a member of the tree-frog family that has given up tree-climbing. *Pseudacris*, however, is an inhabitant of cat-tail marshes and ranges into the fields and meadows in summer, while *Acris* is a frog of open ponds and sluggish streams and does not wander far from them. As in the former species, the disks at the tips of the fingers and toes are much reduced, but they may still be distinguished by attentive examination.

LEOPARD FROG (*Rana pipiens*)

The common spotted frog of our ponds and meadows is usually called "the leopard frog" in published accounts. It is by far the most abundant of the true frogs in our area, and is the one best known to fishermen as the ideal bait for black bass.

This frog is shipped into Chicago from the northwest (Iowa, South Dakota, and Minnesota) in very large numbers. The larger specimens are used for food while during the fishing season the medium sized ones are sold for bait.

It comes out of hibernation very early, and does not sing until some days later. Its voice is a low croaking sound, not carrying more than a few rods from the ponds where it sings.

In late spring and throughout the summer this frog ranges through the meadows in search of its insect food, often far from water. It returns to the ponds or swamps to hibernate. In midsummer the young frogs of this species, just changed from the tadpole stage, may be exceedingly abundant in the neighborhood of ponds and swamps.



NAME: *Trachycarpus Fortunei*
TYPE: Tree
HABITAT: China
CHARACTERISTICS: A tree up to 10 m. tall, with a trunk 10 cm. in diameter at the base. The leaves are lanceolate, 1 m. long, 10 cm. wide, with a petiole 10 cm. long. The inflorescence is terminal, branched, 1 m. long, bearing numerous flowers. The fruit is a drupe, 1 cm. in diameter, containing a single seed.

*PICKEREL FROG (*Rana palustris*)*

The Pickerel Frog is spotted like the Leopard Frog, but its spots are usually larger, nearly square, and in two distinct rows along the sides of the back. The inside surfaces of the thighs are bright yellow or orange when the frog is alive.

As far as known, it occurs in the Chicago area only in northern Indiana, where it is abundant along the little Calumet River, south of the dunes.

Its voice differs strikingly from that of the Leopard Frog, being a prolonged rather uniform snoring sound, but it is even lower in pitch and has less carrying power, so that it is rarely heard.

*WOOD FROG (*Rana cantabrigensis*)*

The Western Wood Frog is easily recognized, in our area, by its pale brown color, unspotted back, and black cheeks. It is known to me only from the Indiana dune region and from Highland Park, Illinois.

Nothing is known of the habits of this frog in the Chicago area. They are doubtless similar to those of the Eastern Wood Frog, which breeds very early in the spring. Except at the breeding season, it is found in shady woods, often far from water.

*GREEN FROG (*Rana clamitans*)*

The Green Frog is decidedly more of a water frog than the Leopard Frog, and does not wander far from water. It comes out of hibernation later and breeds much later than any of the other Chicago frogs except the Bullfrog.

The voice of the green frog is a pleasing 'ktung' or 'ktung-ktung,' like the plucked string of a cello.

The tadpoles of the Green Frog grow larger than those of the Leopard Frog, and require a full year to mature. They pass the winter under the ice and change into the frog stage late in the spring.

The only frog likely to be mistaken for the Green Frog in this region is the Bullfrog. The Green Frog differs from its larger relative in having a glandular ridge or skin fold on each side of the back.

BULLFROG (*Rana catesbeiana*)

The appearance and voice of the Bullfrog indicate that the breeding seasons of the other species of frogs are over. The bass voice of this species doubtless gives it its name. The 'jug-o-rum' or 'brr-wum' of this frog is not likely to be forgotten by anyone who has heard it.

Bullfrogs have been reported in this region only from northern Indiana and from Willow Springs and Waukegan in Illinois. It is a much more abundant species in the south, and supplies the frogs' legs for the table in the Gulf States. Our northern Bullfrogs do not grow as large as southern specimens, which may reach a body-length of eight inches. The largest local Bullfrog in Field Museum's collections measures five and a half inches in length of body.

The tadpoles of the Bullfrog grow even larger than those of the Green Frog and require three seasons to complete their growth. Newly transformed frogs of this species measure about two inches in length of body.

KARL P. SCHMIDT,

Assistant Curator of Reptiles and Amphibians.

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THE SALAMANDERS OF THE CHICAGO AREA

BY

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ASSISTANT CURATOR OF REPTILES AND AMPHIBIANS



ZOOLOGY
LEAFLET 12



FIELD MUSEUM OF NATURAL HISTORY
CHICAGO

1930

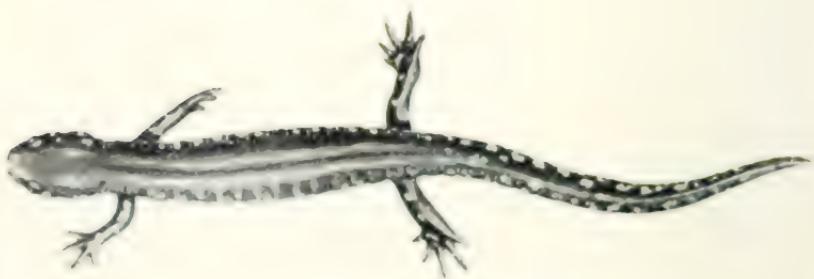
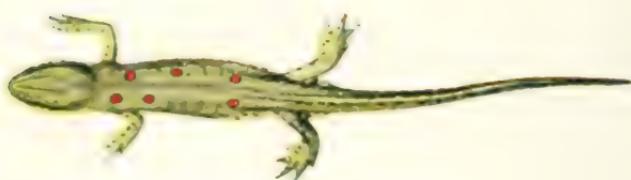
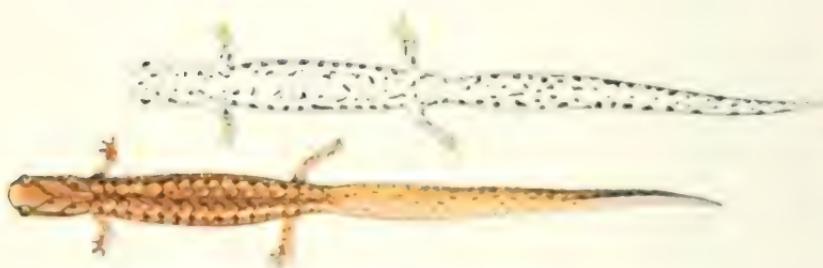
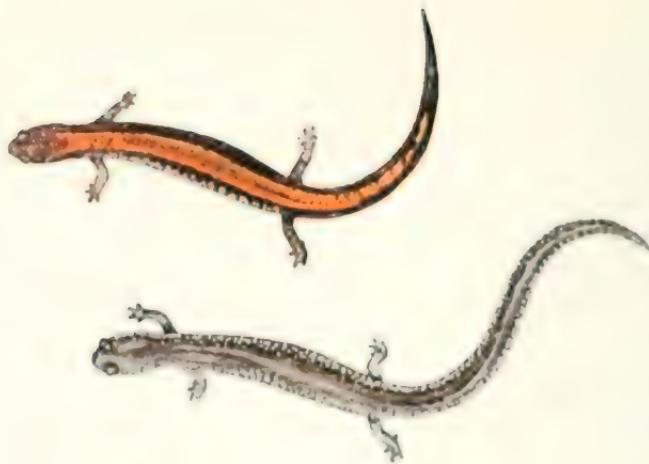
The Zoological Leaflets of Field Museum are devoted to brief, non-technical accounts of the history, classification, distribution and life habits of animals, with especial reference to subjects shown in the Museum's exhibits.

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CHICAGO, U. S. A.



FIELD MUSEUM OF NATURAL HISTORY

DEPARTMENT OF ZOOLOGY

CHICAGO, ILLINOIS

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The Salamanders of the Chicago Area

The environs of any large city inevitably include numbers of people interested in natural history, as well as numerous schools and colleges and, with these, teachers and students interested in zoology and perhaps more or less dependent on the local animal life for study material. The local fauna thus becomes an appropriate subject for leaflets and handbooks designed to afford a simple means of identification of the animals of the area concerned. For the purpose of the series of zoological leaflets to which the present belongs, the "Chicago area" is the area within fifty miles of the center of Chicago. This, accordingly, includes small corners of Michigan and Wisconsin, with wide segments of northeastern Illinois and northwestern Indiana. With the salamanders we complete the treatment of the amphibians of the Chicago area, for the frogs and toads have been dealt with in a former leaflet in this series.¹

While the number of different kinds of salamanders in the area within fifty miles of Chicago is somewhat smaller than the number of frogs and toads, the former are even more interesting to the naturalist. They exhibit a greater diversity of form and structure and a much greater variety of breeding habits. In addition, there are numerous problems about the local species which remain to be solved.

¹Zoological Leaflet No. 11, Field Museum of Natural History, 1929.

The illustrations in the present leaflet, as well as the cover vignette, are the work of Leon L. Pray, who has illustrated so many zoological publications for Field Museum. Special acknowledgment is due him for his painstaking care in the preparation of these drawings and for his unfailing interest in the project of illustrating the local fauna. All of the figures except that of the newt were drawn from specimens from the Chicago area, and the species which are illustrated in color have been painted from living specimens.

The word "salamander" has no very secure meaning in popular usage. In mythology it referred to a creature which was supposed to be able to endure fire with impunity. It is not at all clear that this myth originated with the European "fire salamander" as its basis—it may equally well have had an independent origin, the name being subsequently transferred to the animals we now know as salamanders. Their supposed ability to withstand fire has given rise to numerous technical uses of the word for instruments used in fire—such as the metal drum for coals used in drying plaster—or for the mass of metal or slag remaining in the metallurgist's furnace after the fires are drawn. On account of their lizard-like body form, salamanders are often known as lizards. They may instantly be distinguished from all true lizards by their moist, glandular, and scaleless skin. Lizards being scaled *reptiles* while salamanders are scaleless *amphibians*.

The salamanders form the second of the principal groups of amphibians, the first being the world-wide frogs and toads, while the remaining group, the caecilians, is confined to the tropics. The technical classification is:

Class Amphibia	Order Salientia (frogs and toads)
	Order Caudata (salamanders)
	Order Gymnophiona (caecilians)

The order of the salamanders is divided by students of this group into nine *families*, no less than seven of

which (including the most remarkable forms) are found in North America. The families of salamanders are:

1. Sirenidae	Southeastern North America
2. Hynobiidae	Northeastern Asia
3. Cryptobranchidae	Eastern North America (Ohio River)
4. Amphiumidae	Southeastern North America
5. Proteidae	North America, Europe
6. Ambystomidae	North America
7. Pleurodelidae	North America, Europe, Northern Asia
8. Salamandridae	Europe
9. Plethodontidae	North America, South America

The extraordinary large salamanders of the southeastern United States (illustrated on Plate IV) include the eel-shaped siren which has branched external gills and only one pair of limbs (fig. 1); the similarly shaped but very different Congo snake or lamprey eel (*Amphiuma*) which has no external gills and both pairs of limbs, though these are reduced to an extreme degree (fig. 3); the very flat-bodied, stout-limbed hellbender (*Cryptobranchus*), without gills (fig. 2), notable for its relationship to the giant salamander of Japan and to a European fossil form of Miocene age; and finally, our local fauna includes the water-dog or mud puppy (*Necturus*) (fig. 4), which has well-developed gills and well-developed limbs. The *Necturus* is somewhat obscurely related to the blind European cave salamander, the "olm" (*Proteus*). These forms are conspicuous for their size and for their isolated distributions. The most abundant salamanders of North America are the smaller forms of the family Plethodontidae, a group characterized by the entire absence of lungs. This family contains no less than eighty-six species, which may be grouped into fifteen genera, but only two of its forms are found in the Chicago area.

The life histories of salamanders provide a fascinating subject. Fertilization in all of our species takes place in an extraordinary manner. There is usually a rather well-defined courtship of the female by the male, after which the male deposits a mucous-encased sac of sperm, known as a "spermatophore." This is taken up by the female by means of her cloacal lips, and the spermatozoa then migrate to their special receptacle in the female, the spermatheca, from which they fertilize the eggs as they are laid.

The eggs of all the species which lay in water are much like frogs' eggs, and are frequently mistaken for them in early spring. There is no uniformity, however, in the place or manner of depositing the eggs, and these questions will be discussed under the several species headings below. The eggs segment regularly, and the young salamander hatches as a gill-bearing larva, often provided with a curious pair of rod-like "balancing organs." During the gilled stage, the limbs develop, the front limbs appearing first (which distinguishes them from the early stages of frog larvae). The changes on the occasion of transformation to the adult land stage consist principally in the loss of the branched external gills and a change in the texture of the skin, with considerable internal changes in the skeleton. The mouth parts and feeding habits, unlike those of frog tadpoles, undergo little change.

One of the most remarkable phenomena in the natural history of salamanders is the fact that, under certain conditions, transformation to the land form may not take place at all. The aquatic larva, instead of losing its gills, may become sexually mature and reproduce season after season. This phenomenon, in a species normally with an adult land stage, is called *neoteny*. It is most typically developed in our common tiger salamander of the western states.



MUD PUPPY (*Necturus maculosus*)

The occurrence of neoteny in certain salamanders seems to throw some light on forms like the mud puppy (*Necturus*), which may be thought of as a "permanent larva." It seems evident that in such forms the adult stage has been lost during geologic history and that it is a larval form which is known to us. Such a conjecture is especially warranted in the case of the remarkable Texas salamander from artesian waters (*Typhlonolge rathbuni*), which has been shown to belong to the family Plethodontidae, other members of which invariably have an adult land stage.

Scarcely less remarkable than neoteny is the development of numerous other salamanders on land, which involves the passage of the whole larval life within the egg. This is the case with one of our common species of salamanders, and appears as a definite tendency among the Plethodontid salamanders, culminating in viviparity in their most advanced genus, *Oedipus*, of tropical America.

Salamanders possess remarkable powers of regeneration, in which they are perhaps unique among vertebrates. Lizards are able to reproduce a lost tail, but the new one differs radically in structure from the true tail, and limbs are not regenerated. Frogs successfully regenerate extensive areas of skin, and occasional limb regeneration may take place in adult frogs, but is exceptional. Complete regeneration of limbs is the rule among tadpoles. In salamanders this power of regenerating a limb or tail with its bony structure complete seems never to be lost.

The position and number of ribs in land salamanders is indicated externally by vertical grooves on the sides, the "costal grooves," whose number is frequently useful in distinguishing the species.

Only four of the seven North American families of salamanders are represented in the fauna of the Chicago area which, furthermore, contains only seven species out

of the total of eighty known from North America north of Mexico. The Chicago species are:

PROTEIDAE

1. Mud Puppy (*Necturus maculosus*)

AMBYSTOMIDAE

2. Tiger Salamander (*Ambystoma tigrinum*)
3. Spotted Salamander (*Ambystoma maculatum*)
4. Jefferson's Salamander (*Ambystoma jeffersonianum*)

PLEURODELIIDAE

5. Newt (*Triturus viridescens*)

PLETHODONTIDAE

6. Four-toed Salamander (*Hemidactylum scutatum*)
7. Red-backed Salamander (*Plethodon cinereus*)

KEY TO THE SALAMANDERS OF THE
CHICAGO AREA

- A. Large, bushy, red gills always present; back more or less black spotted on brown ground color, always in water.
Mud Puppy (*Necturus maculosus*).
- AA. Adult without gills.
 - B. Small red spots, edged with black, on the sides.
Newt (*Triturus viridescens*).
 - BB. No small red spots on back or sides.
 - C. Small white spots on back and sides.
Jefferson's Salamander (*A. jeffersonianum*).
 - CC. No small white spots.
 - D. Belly white, with sharply defined black spots.
Four-toed Salamander (*H. scutatum*).

DD. Belly not white.

E. No large yellow spots, back uniform gray or red.

Red-backed Salamander (*P. cinereus*).

EE. Large yellow spots present.

F. Yellow spots in two rows on back.

Spotted Salamander (*A. maculatum*).

FF. Yellow spots irregular on back, in a row along edge of belly.

Tiger Salamander (*A. tigrinum*).

THE MUD PUPPY (*Necturus maculosus*)

The wholly aquatic mud puppy (Plate II) is one of the remarkable large salamanders of eastern North America. It ranges widely to the north and west, from the Atlantic Coast to Saskatchewan, and from the Gulf Coast to Quebec. An allied species (*Necturus punctatus*), somewhat smaller in size, and with a very restricted range, occurs in the Carolinas. Their only relative, within the family Proteidae, is the olm, a blind white cave salamander of the Austrian Alps.

The mud puppy is not very well known to the residents of the Chicago area. Fishermen bring one or two specimens annually to Field Museum for identification. Even the name "mud puppy" is not widely current, and country school children are likely to know them as water lizards.

It occurs somewhat sparingly in the Desplaines, DuPage, and Fox Rivers, and in the lagoons of Chicago parks which are directly connected with Lake Michigan. There seems to be a large population of mud puppies in Lake Michigan with a well-defined annual migration up the inflowing rivers, though definite observations and records on this topic are wanting.

The mud puppy is immediately recognizable by its large size, stout body, short limbs and tail and large,

almost rectangular head, with the unmistakable velvety red gills on the side of the neck. The gills are borne on three fleshy stalks on each side. They are not seen in their normal relation unless the animal is immersed in water and at rest. The color varies from grayish brown to darker brown, with a mottling of darker brown or black spots. Occasional specimens are dark brown all over with small black dots.

The eggs of *Necturus* are deposited singly, each attached by a stalk of the gelatinous envelope to the under sides of stones, logs, or other objects, in varying depths of water up to five feet or more. The eggs are deposited in groups or "nests" with an average of sixty to seventy eggs in each. The time of egg-laying extends through May and June, and hatching seems to take place in June and July. The newly hatched larvae are about 18 mm. (three-fourths of an inch) in length, and have very large yolk sacs which provide them with food until they have doubled their size. The gills are developed and the limbs are represented by "buds" at the time of hatching. The juvenile *Necturus* above 30 mm. in length have a light yellowish line on each side of the back which distinguishes them from any other local salamander larva.

The food habits of the mud puppy must vary in different situations. The under surfaces of rock in the rivers west of Chicago afford an ample supply of insect larvae, small crayfishes, and other invertebrates. They frequently take hooks baited with earthworm, and are probably wholly carnivorous. It is not impossible that the mud puppies in turn are preyed upon by the larger fish. Their relations with the fish fauna of the Great Lakes are quite unknown.

Necturus plays a useful role in North American zoological education, since it is a favorite for dissection in courses in elementary vertebrate anatomy in high schools and colleges. The number sold for this purpose by one

of the biological supply houses in Chicago amounts to about 2,000 specimens per annum.

THE TIGER SALAMANDER (*Ambystoma tigrinum*)

The tiger salamander (Plate III, fig. 2) is a typical representative of the salamander group and is our most familiar form in the Chicago area. The geographic range of this species is an extraordinarily wide one, spanning the North American continent almost from coast to coast, and extending from the Mexican plateau to southern Canada. Various local forms have developed in this widespread population, the one at Chicago being distinguished by its spotted, rather than cross-banded, color pattern. The common name is accordingly much more appropriate for the yellow-banded form of the western plains.

In our area, the tiger salamander is most readily recognized by its large yellow spots, which are irregularly arranged on the back and sides and more or less confluent on the lateral edges of the belly. The spotted sides at once distinguish the tiger salamander from the spotted salamander, the only other species with which it might be confused.

These creatures are subterranean to an extraordinary degree. They are sometimes encountered during the summer in garden soil. In the early fall they migrate overland, at night, to the nearest pond or marsh, where they hibernate and are ready for egg-laying in the spring. It is during this overland migration that they are most frequently observed, for they fall into basement area-ways which serve as pitfalls from which they are unable to escape.

The eggs are laid in clusters three or four inches across in early spring (March), and are usually attached to sticks or weed stems in shallow water. Occasionally they may be laid on the bottoms of ponds, attached to dead leaves or chips or even stones. The number of eggs in a cluster ranges up to at least seventy-five. Egg-laying takes place

soon after the ponds and marshes are free from ice, from the middle of March to early April. The larvae are hatched about fourteen days after the eggs are laid, and require about three months of growth before they are ready to transform into the gill-less adult stage. The newly hatched larvae do not have the curious balanceing organs which characterize the two related forms, the spotted salamander and Jefferson's salamander.

The larvae of the tiger salamander in the plains region of western North America frequently fail to transform and continue to live and grow as gilled larvae without leaving the water. They attain sexual maturity and may then continue in this stage for generations (see above, p. 4). The large larvae are called "axolotles" from the Mexican name of the similar and related forms in the lakes near Mexico City.

Neoteny has been a favorite subject of investigation in recent years, especially with reference to the function of the thyroid in inducing transformation. A curious problem presents itself in this connection with respect to the local tiger salamander, for these are not known to produce axolotles. It would be interesting to experiment with them to see if axolotles could be produced in the laboratory. It seems not impossible that our eastern tiger salamander is in reality more distinct from that of the Great Plains than has been supposed.

THE SPOTTED SALAMANDER (*Ambystoma maculatum*)

The spotted salamander (Plate III, fig. 1) is an abundant form throughout the northeastern United States. It is apparently less abundant in the Chicago area than the tiger salamander. Field Museum has specimens from Willow Springs and from the vicinity of Highland Park.

Like the tiger salamander, the spotted salamander is black or dark brown with yellow spots, and the two species are closely similar in size and body form. The spotted salamander may easily be distinguished by its unspotted

sides and the arrangement of its spots in two fairly regular rows on the back.

The eggs of this form are laid in earliest spring. They are readily distinguishable from those of the other *Ambystomas* by the clear or semi-opaque mass of gelatine which encloses the egg-cluster. The young larvae, for the first two weeks of their life, are provided with a pair of rod-like structures beneath the head, which apparently function as "balancers."

The very remarkable courtship dance of this form was discovered by Mr. and Mrs. Breder, of the New York Zoological Society, in 1926. It has long been known that this species hibernates on land and there is a well-defined migration of great numbers of specimens to the breeding pools in spring. The Breeders found that, at the culmination of this migration, there is a sort of mass courtship in which males and females in woodland pools weave in and out in aggregations composed of large numbers of individuals. This activity doubtless serves to stimulate the females to pick up the spermatophores as they are deposited by the males.

The feeding habits of this species are apparently like those of the tiger salamander. They are found under logs, on the hardwood ridges northwest of Chicago, in early autumn.

JEFFERSON'S SALAMANDER (*Ambystoma jeffersonianum*)

Jefferson's salamander (Plate I, fig. 1) is much smaller than either the tiger or spotted salamanders. Its bluish ground color with irregularly scattered white spots distinguishes it adequately from any other salamander in our area. The white spots are much smaller than the yellow spots of the other two species. To the east and south, however, a similar coloration appears in the wholly unrelated slimy salamander (*Plethodon glutinosus*), a member of the family Plethodontidae.

Jefferson's salamander ranges from New England to Minnesota and southward to Virginia and Illinois. It is abundant under logs and railway ties in the Dune region, in early fall, and under logs on the wooded moraine northwest of Chicago. It doubtless occurs throughout the originally timbered section of the Chicago area.

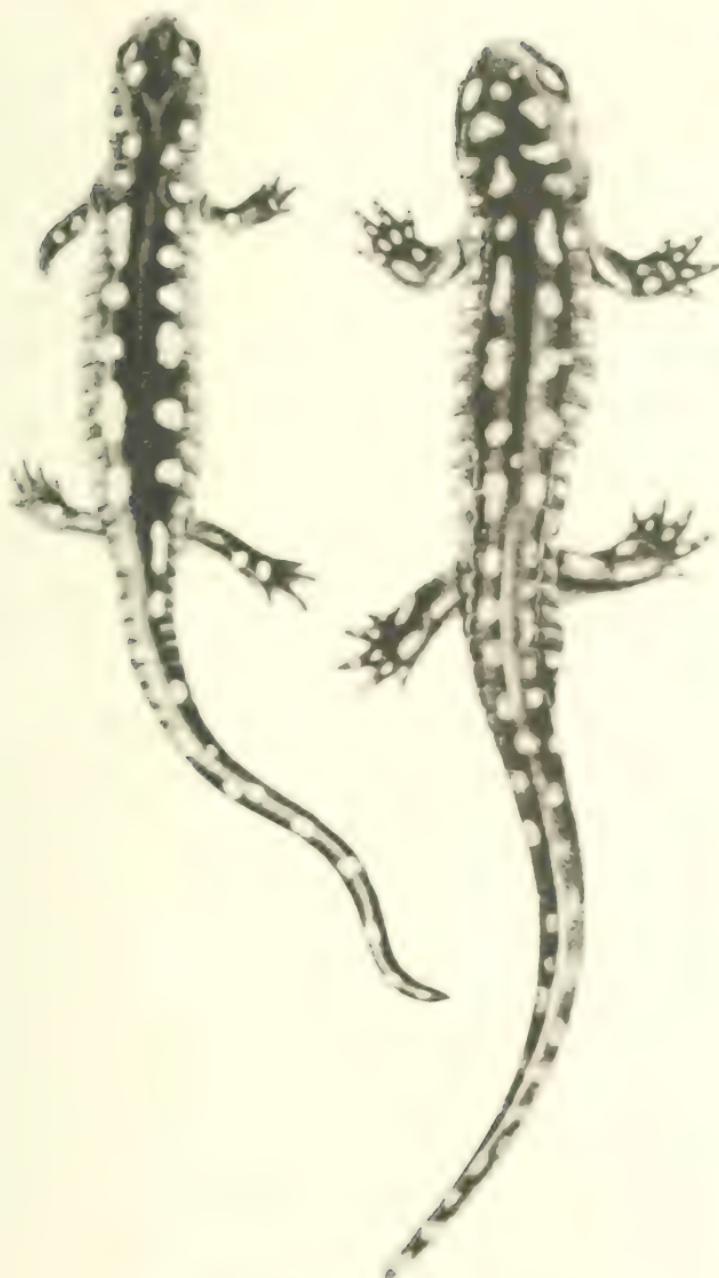
The egg masses of this species are much looser than those of the two related forms, and the number of eggs, averaging about fifteen, is much fewer. Egg-laying takes place at an earlier date than in either of the other species, almost as soon as the ponds are free from thick ice. The larvae have balancers like those of the spotted salamander, so that they are easily distinguished from tiger salamander larvae. They may be distinguished from the larvae of the spotted salamander by the concentration of the black pigment on the sides into fairly well-defined spots.

THE COMMON NEWT (*Triturus viridescens*)

The common newt (Plate I, fig. 2) ranges throughout the eastern United States, but is singularly rare in the Chicago area. It has been collected at Hesseyville, Indiana, and in the Skokie marsh west of Highland Park.

The newt is easy to distinguish from any other salamander in our area by its coloration, olive or yellowish green with a row of black rimmed scarlet spots on each side, and with sharply defined black spots on the belly.

The life history of this species has received a good deal of attention. The male newt, during the breeding season, has the tail-fin so much widened that it is twice as broad as that of the female, and the hind limbs are much enlarged and provided with horny pads on their inner sides. The head of the male is provided with glands which appear to stimulate the female during the highly complicated courtship. The body of the female, distended with eggs, is plumper than the male, so that the sexes are very easily recognized. The eggs are laid singly, usually



AMPHIBIANS OF THE FOREST AREA

I. Spotted salamander

II. Tiger newt

attached to water weed. The larvae go through a normal gilled stage and transform when they are about an inch in length. The juvenile terrestrial form, in northeastern North America, is bright coral red and is an abundant form beneath logs, chips, and stones on any wooded hill-side near water. This red land stage, in which newts are known as "red efts," is apparently wanting throughout the southern states and the Atlantic coastal plain, and is unknown at Chicago. This land stage has a duration of about three seasons, after which the newt returns to the water to breed and, thereafter, resides permanently in the ponds.

Nothing at all is known of the behavior in this respect of the newt in the Chicago area. No "red efts" have ever been reported, and it would be interesting to know if a land stage occurs and, if so, if it is a normal stage in the life history. Newts from the Chicago area are much desired by Field Museum. The figure (Plate 1, fig. 2) represents a specimen from Pennsylvania.

The European newts are favorite aquarium animals. They feed readily on bits of meat or worm or small insects. Their remarkable courtship antics are an unfailing attraction and are not confined to spring. They breed freely in captivity and hybridize to a considerable extent. Such studies might profitably be made in this country, though we do not have the astonishing variety of species of the newt group that distinguishes the European salamander fauna.

THE FOUR-TOED SALAMANDER (*Hemidactylum scutatum*)

The four-toed salamander (Plate 1, fig. 3) occurs throughout eastern North America, with the exception of Florida, a range nearly as extensive as that of the common newt. In our area it has been found only in the region west of Highland Park.

This species is well distinguished by its coloration as well as by the reduction of the toes on the hind foot to

four. The china-white belly is not merely pale but has a deposit of white pigment, against which the small black spots are even more sharply defined than are those of the newt. The costal grooves are sharply bent on the back, which somewhat resembles scaling, and from this character is derived the scientific name *scutatum*. There is a definite constriction at the base of the tail.

The breeding habits are remarkable in that they illustrate a transitional stage between the purely aquatic development of most salamanders and the terrestrial breeding habits of the more advanced plethodonts. The eggs are laid at the edges of ponds or in moss in sphagnum bogs several inches above the water, and are guarded by the female which coils about them. They require about five weeks to hatch, and the duration of larval life, which is passed in the water, is about six weeks. Egg-laying in this latitude takes place about mid-April.

As has been mentioned in the introductory notes, salamanders are capable of complete regeneration of a lost tail or limb. In a number of forms loss of the tail forms a definite defensive procedure, the tail being cast off when the salamander is attacked by an enemy, in order to enable its owner to escape, while the tail, actively squirming and wriggling with reflex motion, occupies the attention of the enemy. This phenomenon, when the tail is provided with special breakage planes for the purpose, is known as *autotomy*. In the four-toed salamander the tail is provided with such a breaking point near its base, as may be seen in the figure. It is the only species in our fauna with the breaking point so restricted.

THE RED-BACKED SALAMANDER (*Plethodon cinereus*)

The red-backed salamander (Plate I, fig. 4) is the smallest species of salamander in the Chicago fauna. Its identification offers a difficulty in that it occurs in two color phases, one red-backed and the other uniform gray,

It is easily distinguishable, however, by elimination of the distinctive characters of the other species—it has neither white nor yellow spots, and has no sharply defined black dots on the belly like those of the newt or the four-toed salamander. Adult breeding males have swollen snouts, nasolabial grooves and elongated premaxillary teeth. These may readily be distinguished by examination with a hand lens. They produce a somewhat angular outline in the shape of the head.

It has almost exactly the same range as Jefferson's salamander—the whole of northeastern North America, ranging well north into Ontario and Quebec. It is pronouncedly a salamander of the forested region, living in and beneath decayed logs, where the wealth of small insect life affords an ample food supply.

The life history is interesting for its complete adaptation to land life. The spermatophores are probably transferred from the male to the female in late autumn. The eggs, five to thirteen in number, are deposited in the crevices of damp logs, probably no earlier than June, and often as late as August. The young salamanders complete their development within the egg and hatch as small replicas of their parents.

The two color phases occur in about equal numbers, and have nothing to do with sex or habitat.

Observations of egg-clusters of this species in the Chicago region are much to be desired. Terrarium observation might yield important information as to the mode of transfer of the spermatophores from male to female, and the courtship activities, which doubtless exist, are wholly unknown.

Karl P. Schmidt,
Assistant Curator of Reptiles and Amphibians

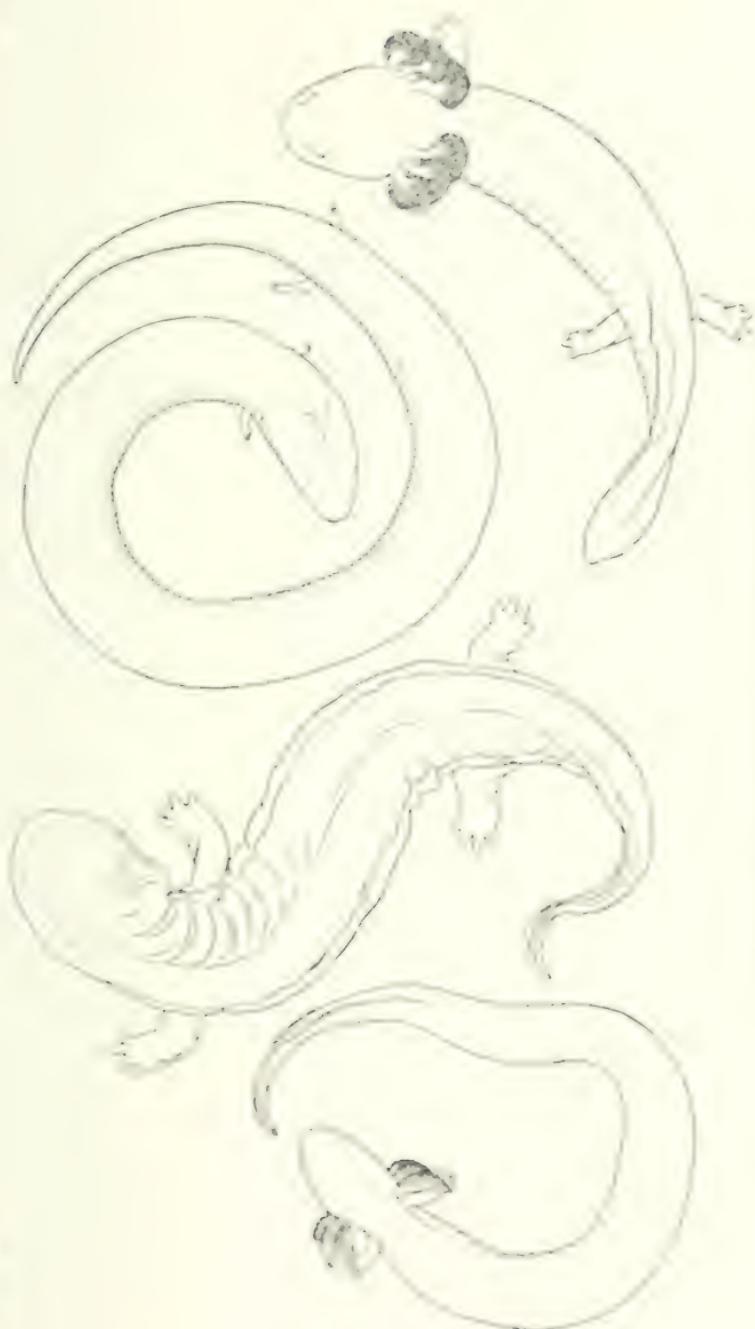
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Fig. 10 (1)

Fig. 10 (2) *Leucaspis* sp. (Hymenoptera: Encyrtidae) on *Leucaspis* sp. (Homoptera: Pseudococcidae).

Fig. 10 (3)



Sculptures by Herbert Haseltine
of
Champion Domestic Animals
of Great Britain

PRESENTED TO FIELD MUSEUM
BY TRUSTEE MARSHALL FIELD



ZOOLOGY
LEAFLET 13

FIELD MUSEUM OF NATURAL HISTORY
CHICAGO
1944

The Zoological Leaflets of Field Museum are devoted to brief, non-technical accounts of the history, classification, distribution and life habits of animals, with especial reference to subjects shown in the Museum's exhibits.

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STEPHEN C. SIMMS, DIRECTOR

FIELD MUSEUM OF NATURAL HISTORY
CHICAGO, U.S.A.

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FIELD MUSEUM OF NATURAL HISTORY

DEPARTMENT OF ZOOLOGY

CHICAGO, ILLINOIS

LEAFLET NUMBER 13

SCULPTURES OF
CHAMPION DOMESTIC ANIMALS
OF GREAT BRITAIN

INTRODUCTION

The series of sculptures of British prize domestic animals, on permanent exhibition in Hall 12 at Field Museum of Natural History, provides an excellent representation not only of the particular champions which were used as models, but also of types illustrating well the physical characteristics of various outstanding breeds of live stock.

The models, some carved in stones of various hues and textures chosen especially for their suitability to reproduce the colors and characteristics of the different animals, and some, where appropriate, cast in bronze, are the work of the noted sculptor, Mr. Herbert Haseltine. The Museum's acquisition of them is due to the generosity of Mr. Marshall Field, Trustee of the institution.

Work on the series was begun by the sculptor in the summer of 1921, at which time the Champion Shire Stallion, FIELD MARSHAL V, from the stables of King George V, was modeled. The original models of other animals were made between 1922 and 1924, in various parts of England, Ireland, and Scotland, and the collection was augmented and perfected in succeeding years. In 1925 the series was exhibited in Paris and in London.

Great Britain as a nation has long encouraged the breeding of fine horses and stock of all kinds, and in

consequence her champions are indeed worthy of having their glory perpetuated in stone by an artist whose special gifts in this field have won him wide acclaim. In similar fashion it was the custom of the ancient Greeks to erect monuments not only to their gods and their human heroes, but to noble steeds which won chariot races.

The animals represented in the sculptures exhibited in Field Museum, and pictured in this leaflet, are actual winners whose mettle has been proved in stock shows and on race courses. To model them the sculptor made studies of them in their various moods and postures, visiting their stables, their stalls, and their pens. The sculptures are one-quarter life size.

The bulls represented include the breeds known as the Aberdeen-Angus, the Shorthorn, and the Hereford. The Aberdeen-Angus is a Scottish breed, black-coated, and without horns. It is typified by a strong bony frame of moderate dimensions carrying a heavy mass of flesh. The champion represented in this series is a bull known as **BLACK KNIGHT OF AUCHTERARDER**.

The Shorthorns, another Scottish breed, are represented by a magnificent specimen, **BRIDGEBANK PAYMASTER**, prize winner both in England and Scotland for three successive years, whose victory is still remembered by officials of the show ring. The sculpture of this animal has been executed appropriately in red marble.

Chosen as characteristic of the Herefords was a bull named **TWYFORD FAIRY BOY**. This is an animal with a dark red coat in contrast to which are a white head, legs, and tail. Its hair is almost as curly as that of a sheep.

Two Lincoln rams and a Southdown were selected to represent the sheep. The Lincoln breed is celebrated for the luxuriance and high quality of its wool. The Southdown is highly esteemed for its delicious meat—so highly, in fact, that the breeders say that the meat of the Lincoln variety is fit only to furnish candles to light the banquet at which Southdown mutton is served.

The collection includes models of three extraordinary swine—two of the Middle White breed and a Berkshire. The Middle Whites are carved in pink marble. They are descendants of a Chinese breed which was imported into Yorkshire in the eighteenth century, and they are still characterized by the squat turned-up nose and stiff ears of their remote ancestors. The Berkshires are one of the best known and commonest varieties of pigs, and are raised in great numbers in the United States as well as Great Britain.

The deviations from nature achieved by the breeders, represented in these bovine and porcine models by such refinements as the pig's vast shiny bolster and the sheep's huge woollen blanket, have been modeled by the artist so as to reproduce faithfully their actual shapes, with a classic treatment of their outlines in the manner of the ancient sculptors of Egypt, China, and Greece.

Among the sculptures of horses are representations of both the finest types of powerful heavily built draft horses and the fleet-footed light-framed sleek performers of the race course and the polo field. The characteristics of the strong patient draft horse are at once recognized in the Shires with their feet flounced with hair, and in the Suffolk Punch, whose qualities recall days when horses bore knights with heavy coat-of-mail, and caparison. Rivals to these are the three French Percherons, imported into England since the war. The individual traits of each member of this group are displayed—the sire arches his neck and turns away as if to neigh, while the dam stretches tenderly towards the foal, which clings closely to her flank. In sharp contrast to the draft horses appears the silhouette of the thoroughbred, SERGEANT MURPHY, holding its head victoriously. This horse, winner of the Grand National at fourteen years of age, is a splendid specimen of steeplechaser. Another champion of the track is POLYMELOS, winner of many races on the flat, and, in 1916, 1920, and 1921, at the head of the list of winning

sires. Polymelus' posterity includes horses which have won a total of more than a million dollars (£220,000). This champion of the track and sire of champions was modeled by the artist a few months before its death. Decrepit as the horse was at that time, its fine proportions, depth of shoulder, and length of rein are still discernible in the sculpture.

The type of heavy-weight polo pony is represented by PERFECTION. This horse was bred in Ireland, but its forebears are unknown. Stocky and strong on the legs, Perfection is an admirable specimen of the ponies, which are as keen at the game as the players who ride them.

In an appreciation of the artist's work by the late Georges Bénédite of the Académie Française are found the following words which well express what has been accomplished in this series of sculptures:

"In the course of his close study of these wonderful examples of British breeding, Haseltine has been brought into contact with all those interested in their welfare, from owners to stud-grooms and herdsmen, and has been able to draw upon the knowledge accumulated by them from day to day to supplement his own powers of observation. His chief merit lies in his having realized that the pursuit of their utilitarian ideal of the best furnishes the artist with the essentials for his own pursuit of the beautiful. To give to the line the simplest expression, to reconstruct nature's handiwork in accordance with man's directions, to feel in it and to give to it its due proportion and to endow it with the technical detail which every aspect demands, can alone satisfy the true artist and constitute a true work of art."

1. SHIRE STALLION: FIELD MARSHAL V.
Foaled 1917. Sire CHAMPION'S CLANSMAN. Dam: EARLY PRIMROSE. Bred by and
the property of His Majesty King George V, Sandringham stud.
First and champion at the Show of the Shire Horse Society, 1920 and 1921.
Chiseled bronze plated with gold, mounted on porphyry base



2. SHIRE STAMION: HARBORO' NULLI SECUNDUS.

Foaled 1914. Sire: BABINCLEY NULLI SECUNDUS. Dam: TATTON PRINCESS. Bred by W. T. Hayr, and the property of Mrs. Stanton, Sheldon Hall, Derbyshire, England.

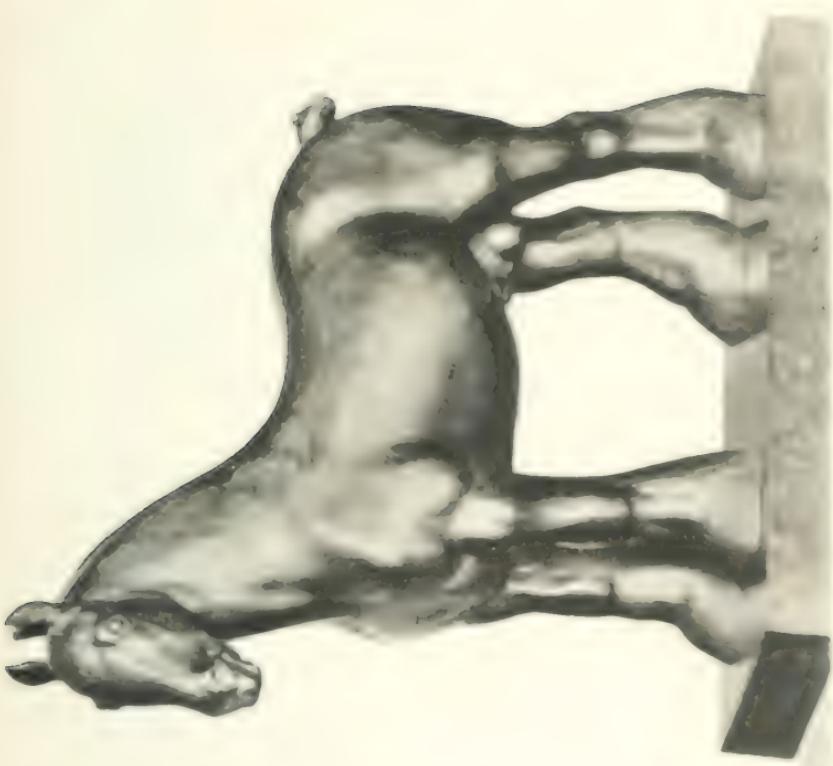
First and Reserve Junior Champion at the Show of the Shire Horse Society, 1917

First and Reserve Champion at the Show of the Shire Horse Society, 1918

First and Champion at the Show of the Shire Horse Society, 1922 and 1923

First and Champion at the Show of the Royal Lancashire Society, 1923

Chiseled bronze plated with gold, mounted on porphyry base.

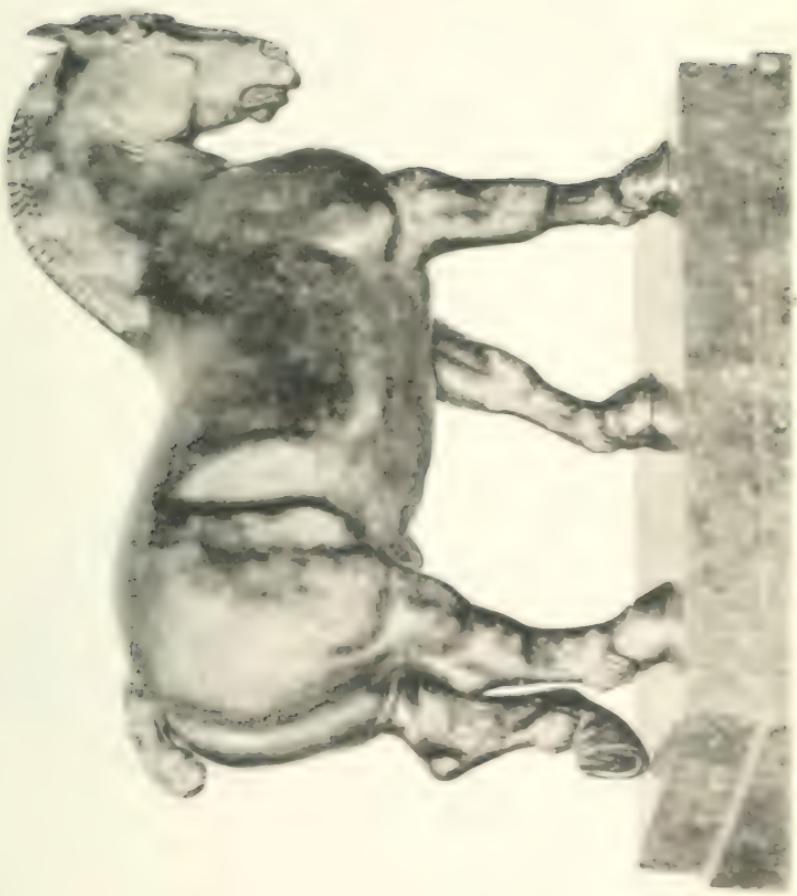


3. SUFFOLK PINCH STALLION: SUDBOURNE PREMIER.

Bred 1919. Sire: SUDBOURNE BEAU BECADER. Dam: SUDBOURNE MONSTRELL.
Bred by the late Lord Manton, and the property since July 11, 1923, of Percy C.
Vane, Weston Park, Wickham Market, England.

- First and "Champion" at the show of the Royal Agricultural Society of England, 1923 and 1924
First and "Champion" at the Suffolk Show, 1923 and 1924
First and "Champion" at the Woodbridge Show, 1923
First at the Norfolk Show, 1923
First and "Champion" Victory Challenge Cup, Woodbridge, 1924
First at the Ipswich Show, 1924
First at the Norwich Spring Show, 1924
First Suffolk Stallion, 1924
First at the Ipswich Show, 1924
First at the Norfolk Show, 1924

Bronze plated with gold and ornamented with lapis lazuli, ivory, and onyx



4. PERCHERON STALLION: RHUM.

Foaled 1917. Sire: LAGOR. Dam: MAZIRKA. Bred by M. Chopin, La Bigottière, Bellême, Mortagne, France, and the property of Mrs. Robert Emmet, the Greyling Stud, Moreton Morrell, Warwickshire, England.

First at Mortagne, 1919.

First and Champion at the Show of the Royal Agricultural Society of England, 1921, 1922, and 1923.

First and Champion, Norwich Stallion Show, 1922 and 1923.
Bardiglio marble.



5. PERCHERON MARE: MESSALINE (AND FOAL).

Foaled 1912. Sire: DOTTY-EX-COLVETTE. Dam: PAQUERETTE. Bred in France, and the property of Mrs. Robert Emmet, the Greyling Stud, Moreton Morrell, Warwickshire, England.

First, in Mortlake Show, 1911, 1918, and 1919

First at the Show of the Rival Counties Agricultural Society, 1910

First and current Prince at the Show of the Norfolk Agricultural Society, 1920

First at the Show of the Royal Agricultural Society of England, 1920

First, Moretonmorrell Mart, 1920.

First and Champion at the Shows of the Royal Agricultural Society of England, 1921 and 1922

Bardiglio marble



6. COMPOSITE TYPE; THE THOROUGHBRED HORSE.

Bronze.



7. THOROUGHBRED HORSE: POLYMERUS.

Foaled 1902. Died March, 1925. Sire: CYLLENE. Dam: MAID MARION. Bred by the Marquis of C'rewe, and the property of S. B. Joel. Champion sire for five years. His progeny won over £220,000. Among them were:

BLACK JESTER, winner of the St. Leger and City and Suburban.

POMMERS, winner of the Two Thousand, Derby, and St. Leger.

FIFELIA, winner of the Oaks and Derby.

CORVRA, winner of the Middle Park Plate and Newmarket Stakes and second in the Two Thousand Guineas.

BENEVENTE, winner of the Middle Park Plate.

MAIDEN ERLEIGH, winner of the City and Suburban and second in the St. Leger.

POLKERRIS, winner of the Coronation Stakes.

ARCHAIC, winner of the Atlantic Stakes and second in the Derby.

DOMINION, winner of several races and second in the St. Leger.

SILVERN, winner of the Greenham Stakes and second in the St. Leger.

POLYGNOTUS, winner of the Greenham Stakes.

HUMOKIST, winner of the Derby.

CINNA, winner of the One Thousand Guineas and Coronation Stakes and second in the Oaks. POLYMETIS, winner of the Column Produce Stakes.

POMME-DE-TERRE, winner of the Manchester Cup.

GOLDEN GUINEA, winner of the Richmond Stakes.

Prizes won by POLYMERUS: the Richmond Stakes, Goodwood; the Rous Memorial Stakes, Newmarket; the Criterion Stakes, Newmarket; the Fifty-second Triennial Stakes, Ascot; the Durham Produce Stakes, Stockton; the Duke of York Stakes, York; the Gatwick Stakes. Since being purchased by S. B. Joel, has won the Duke of York Stakes, Kempton Park; the Champion Stakes, Newmarket; the Cambridgeshire Stakes, Newmarket; the Princess of Wales Stakes, Newmarket.

Bronze.

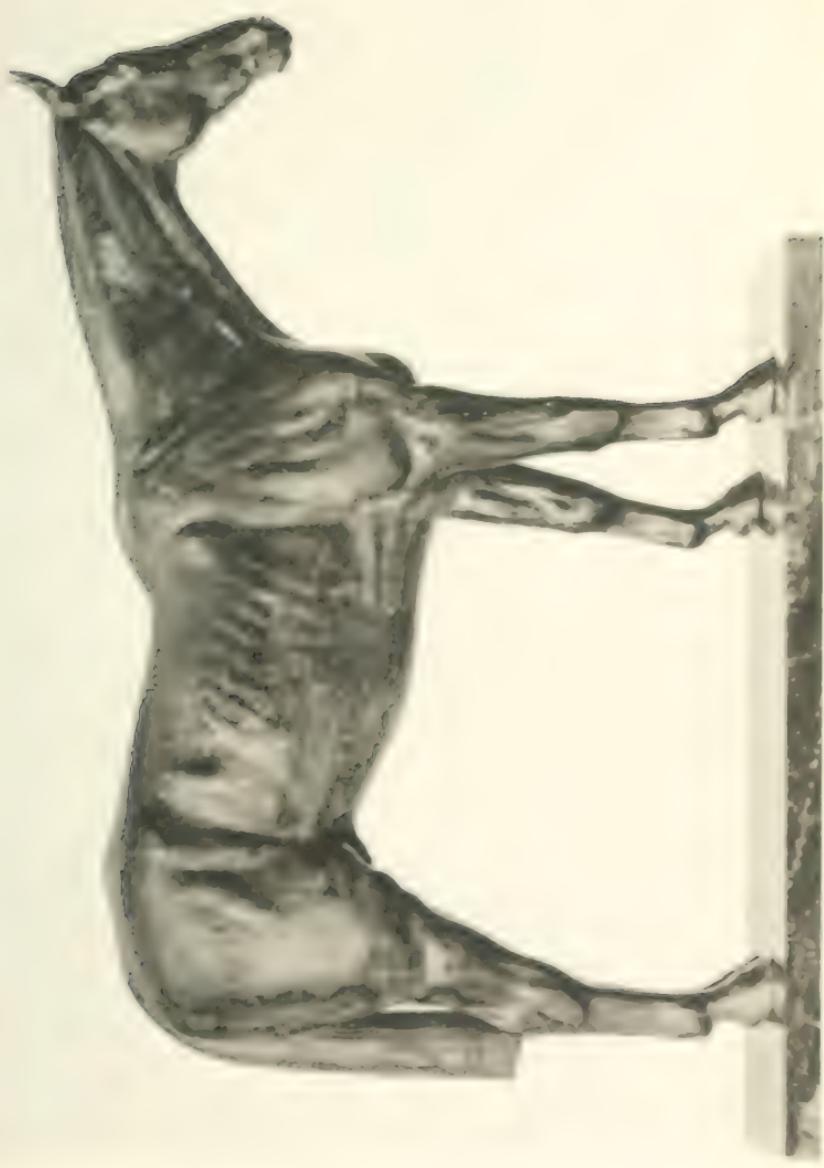


8. THE CHASER: SERGEANT MURPHY.

Foaled 1910. Chestnut gelding. Sire: GENERAL SYMONS. Dam: ROSE GRAFT by ASPECTIC by ROSE STOCK by PRESTON PANS by ROSELEAF by FRIGHT. Bred by G. L. Walker, Athboy, County Meath, Ireland, and the property of S. Sanford.

Winner of the Grand National, 1923.

Bronze.



9. POLO PONY: PERFECTION.

Fouled 1915. Pedigree unknown. The property of Major J. F. Harrison, King's Walden Bury, Hitchin, England.

Champion Heavy-weight Polo Pony at Hurlingham and Ramelagh, 1922, 1923, and 1925.
First at Olympia, 1923 (only time shown).

Chiseled bronze.



10. ABERDEEN-ANGUS BULL: BLACK KNIGHT OF AUCHTERARDER.
Calved April 26, 1919. Sire: EVMAR. Dam: BLACKBIRD V OF BRAEVAILL. Bred by
A. T. Reid, and the property of Sir Leonard Brassey, M.P., Apethorpe Hall, Peter-
borough, England.

Champion at the Show of the Royal Agricultural Society of England, 1921, 1922, and 1923.

Champion at the Show of the Highland and Agricultural Society of Scotland, 1921 and 1922.

Black Belgian marble.



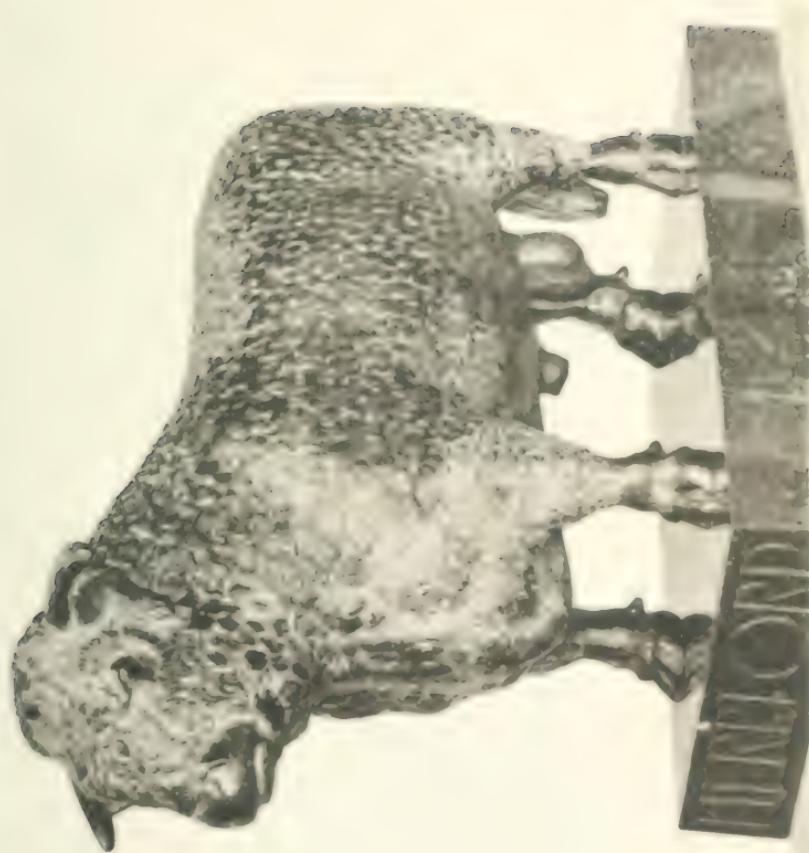
11. SHORTHORN BULL: BRIDGEBANK PAYMASTER.

Calved January 28, 1919. Sire: GAINFORD RINGLEADER. Dam: PRINCESS CHRISTINA. Bred by and the property of Albert James Marshall, Bridgebank, Stranraer, Scotland. First and champion at the Show of the Royal Agricultural Society of England 1921, 1922, and 1923. First and Champion at the Show of the Highland and Agricultural Society of Scotland, 1921, 1922, and 1923.

Red Acajou marble.



12. HEREFORD BULL; TWYFORD FAIRY BOY.
Calved January 16, 1920. Sire: BOUNDS INVESTMENT. Dam: FAIRY GIRL III. [pre] by and the property of Charles H. Tinsley, Twyford, Twyford, England.
First and champion in 1920 at the Shows of the Royal Agricultural Society of England, the Bath and West Society, the Shropshire and West Midland Society, and the Three Counties Society
Bronze partially plated with gold.



13. DAIRY SHORTHORN COW: LILY CHARTER 2ND.

Calved March 28, 1916. Sire: THORNEYCROFT RICHARD. Dam: LILY CHARTER.
Bred by Frank Bird, Mill Lane, Neston, Birkenhead, England. Purchased as a calf
two months old by the Duke of Westminster, Eaton Hall, Cheshire, and by Lawrence
Hignett, Hook End, Cheekendon, Reading, September 3, 1923.

First and Female Champion and in groups which won 100 guineas (\$111.60)
Silver Challenge Cups at the Show of the Royal Agricultural Society of England, 1923 (only time
exhibited).

Chiseled bronze partially plated with gold.



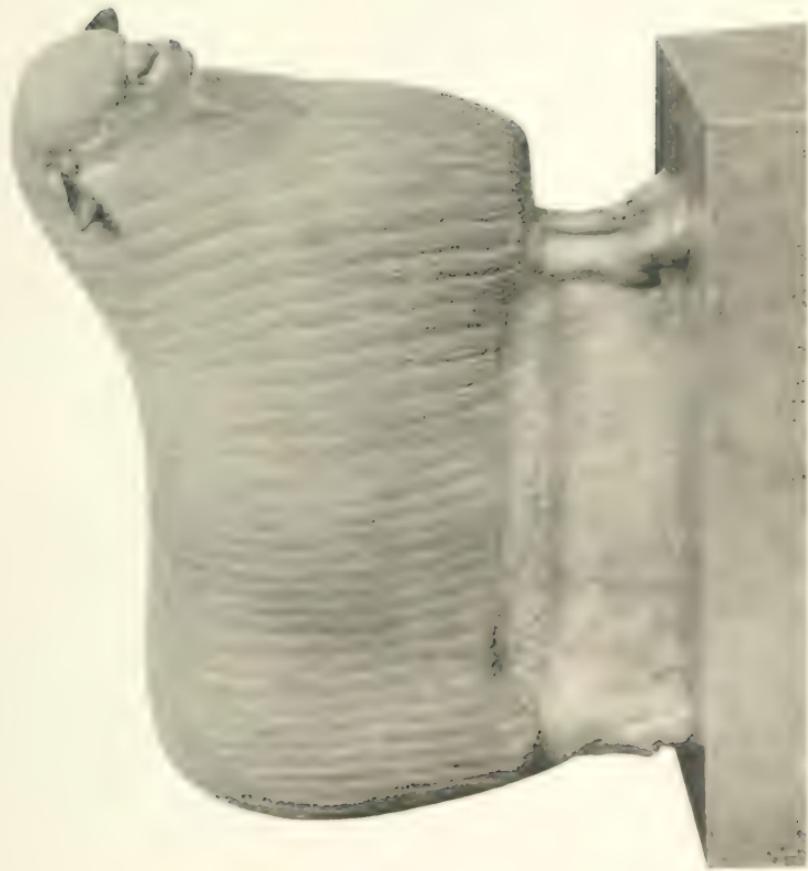
14. LINCOLN RAM: CONQUEROR (1921).

Sire: PATTERN SQUIRE. Bred by C. W. Tindall, and the property of C. W. Tindall and Major W. H. Rawnsley, at Thornton House, Hornastle, England.

First and Champion at the Show of the Royal Agricultural Society of England, 1921.
First at Lincoln Show and Sale, 1921.

First and Champion at the Yorkshire Show, 1922.

Burgundy limestone.



15. LINCOLN RAM: CHALLENGER (1922).

Sire: Dowsby Pride. Bred by C. W. Tindall and Major W. H. Rawnsley, at Thornton House, Hornsby, England.

First Two-shear and Champion at the Show of the Royal Agricultural Society of England, 1922.

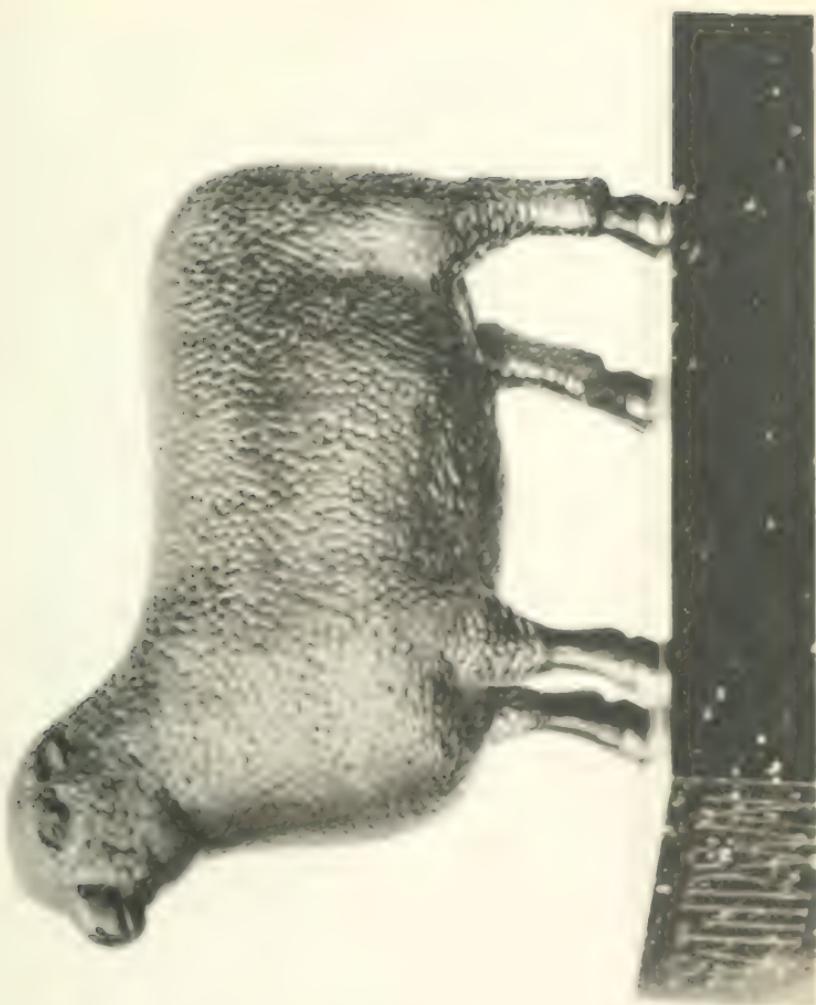
First at the Lincolnshire Show, 1922.

Second and Reserve Champion at the Yorkshire Show, 1922.

Burgundy limestone.



16. SOUTHDOWN EWE: SANDRINGHAM EWE NO. 10 OF 1921.
Sire: Goodwood 68 of 1919. Dam: SANDEINGHAM 24 of 1919. Bred by and the property of His Majesty King George V. Sandringham flock.
One of the Champion Pen of Ewes at the Show of the Royal Agricultural Society of England, 1921.
Bronze plated with gold.



17. MIDDLE WHITE BOAR: WHARFEDALE DELIVERANCE.

Breeding and the property of Leopold C. Page, Middlethorpe Hall, York, England

First at the Royal Lancashire Show, 1910

First and Reserve Champion at the Show of the Royal Agricultural Society of England (See)

First and Champion Boar at the Royal Lancashire Show, 1911

First and Champion Boar at the Show of the Royal Agricultural Society of England (See)

First and Reserve Champion Boar beaten by his son Champion Wharfedale Champion at the Yorkshire Show, 1912

Reserve Champion of boars at the Show of the Royal Agricultural Society of England (See) and first being beaten by his daughter, Wharfedale Champion and Wharfedale Royal Champion respectively

First and Champion at the Yorkshire Show, 1913

Rose St. Georges marble.



18. MIDDLE WHITE SOW: WHARFEDALE ROYAL LADY.

Bred by and the property of Leopold C. Page, Middlethorpe Hall, York, England.
First and Breed Champion at the Show of the Royal Agricultural Society of England (9th and 10th)

First and Champion at the Yorkshire Show, 1923

Rose St. George's marble.



19. BERKSHIRE BOAR: HIGHFIELD ROYAL PYGMALION.

Sire: Pygmalion. Dam: Eaton Princess Royal Third. Bred and exhibited by Frank Townend, Highfield, Moor Allerton, Leeds, England, and the property since January, 1923, of the Duke of Westminster.

First and Breed Champion at the Show of the Royal Agricultural Society of England, 1922.

First and Champion at the Yorkshire Show, 1922.

Chiseled bronze partially plated with gold.



TURTLES OF THE CHICAGO AREA

BY

KARL P. SCHMIDT

CURATOR OF AMPHIBIANS AND REPTILES



ZOOLOGY
LEAFLET 14



FIELD MUSEUM OF NATURAL HISTORY

CHICAGO

1948

The Zoological Leaflets of Field Museum are devoted to brief, non-technical accounts of the history, classification, distribution and life habits of animals, with especial reference to subjects shown in the Museum's exhibits.

LIST OF ZOOLOGICAL LEAFLETS ISSUED TO DATE

1. The White-tailed Deer	\$.10
2. Chicago Winter Birds . . . . .	.10
3. The American Alligator . . . . .	.10
4. The Periodical Cicada . . . . .	.10
5. The Alligator Gar . . . . .	.10
6. The Wild Turkey . . . . .	.10
7. The Man-Eating Lions of Tsavo . . . . .	.50
8. Mammals of the Chicago Area . . . . .	.20
9. Pike, Pickerel and Muskalonge . . . . .	.50
10. The Truth about Snake Stories . . . . .	.15
11. The Frogs and Toads of the Chicago Area . . . . .	.25
12. The Salamanders of the Chicago Area . . . . .	.25
13. Sculptures of Champion Domestic Animals of Great Britain . . . . .	.25
14. Turtles of the Chicago Area . . . . .	.25

CLIFFORD C. GRIGG, Director

FIELD MUSEUM OF NATURAL HISTORY
CHICAGO, ILL., U.S.A.

PLATE I

FIG. 1



CUMBERLAND TERRAPIN



BLANTON'S TURTLE



BLANTON'S TURTLE

REVIEW PATTERNS OF TURTLES OF THE CHESAPEAKE AREA

FIELD MUSEUM OF NATURAL HISTORY

DEPARTMENT OF ZOOLOGY

CIRCA, 1908.

LEAFLET NUMBER 14
October 1908 at Field Museum of Natural History

TURTLES OF THE CHICAGO AREA

The turtles found within fifty miles of Chicago offer an excellent subject for one of several leaflets designed as introductions to the systematic study of local animal life for the use of students, teachers, and naturalists, in the territory surrounding Chicago. The Chicago amphibiae have been covered by two leaflets, one on the frogs and toads, and one on the salamanders.

In the preparation of the present leaflet, I am especially indebted to Mr. Leon L. Gray, of the taxidermy staff of Field Museum, for the preparation of the accurate color sketches which illustrate the characteristic head coloration of nine of our species of turtles, and for the stippled drawings in black and white to illustrate "recognition characters" of each species. With the aid of these figures the identification of any specimen from this region is much simplified.

The turtles belong to the great group of reptiles, of which they form one of the major divisions, the order Testudinata. Turtles are distinguished among reptiles by the fact that few persons regard them with fear or aversion. They are scarcely less remarkable for the want of popular confusion as to their name or definition. There are, to be sure, three current names for these creatures: turtle, tortoise, and terrapin. An Englishman is likely to restrict "turtle" to the marine turtles, which include the edible "green turtle," employing "tortoise" for all the other land and fresh-water forms. An American is likely to think of "tortoise" as applying to the land or desert forms,

and to give a wider application to the word "turtle," but with the addition of the term "terrapin" to his vocabulary for certain of the fresh-water forms which abound in the eastern United States. It seems preferable to adopt the word "turtle" for the group as a whole and to distinguish sea turtles, land turtles, soft-shelled turtles, and others, by means of a suitable prefix; such forms as "snapping turtle" and "spotted turtle" are already fixed in the language in America; "snapping tortoise" and "spotted tortoise" are not current.

Turtles are widely used as food. The marine green turtle, which grows to large size, is famous for the soup made from it in all maritime countries. In the United States the fresh-water turtles are frequently eaten, including the forms indiscriminately known as "terrapin" or "sliders," the snapping turtle, and the soft-shelled turtles. In the eastern United States the diamond-backed terrapin of the salt marshes enjoys an extraordinary reputation as a delicacy. Diamond-backed terrapins formerly brought eight to ten dollars each in the larger cities. This artificial price has its counterpart in China, where certain species of soft-shelled turtles are especially valued. Turtle-raising for the market is extensively practiced in Japan. Considerable success has attended experiments with diamond-backed terrapin culture in this country under the direction of the United States Fish Commission, at Beaufort, North Carolina.

Young specimens of several of our common turtles are familiar as aquarium pets. The giant land turtles afford an especial attraction in zoological gardens, where their longevity makes them favorites with their keepers. One of the large tortoises of the islands in the Indian Ocean, transported when it was already full-grown from its native home to the Island of Mauritius, in 1766, lived until 1918. This known span of more than 152 years is perhaps the greatest age reached by any vertebrate for which authentic records are available. It is believed that many

of the smaller species of turtles are also very long-lived, and it is certain that many have a possible length of life of more than 50 years.

The turtles quite plainly represent the most ancient type of reptile now living. They are more ancient, indeed, than most of the dinosaurs and related reptiles that flourished in the "Age of Reptiles." They appear as fossils at the beginning of that period and even the earliest known forms are already unmistakably turtles, with the principal characters of the group well developed. These characters are primarily the presence of a boxlike bone shell, within which the head and limbs can be withdrawn; and the absence of teeth, the jaws being provided with sharply-edged horny sheaths. The solidly built skull shows the relationship of the turtles to the most primitive of the ancient reptiles of the Permian Age. The bony box which composes the shell is made up of numerous dermal bones (bones formed in the skin), which are fused with the much flattened ribs in the upper shell, and with the sternum in the ventral shell. The upper shell is the carapace, the lower the plastrum. The horny shell is covered with soft skin in the soft-shelled turtles, in all others with a series of symmetrically arranged horny plates. The horny plates and the underlying bones of the shell do not correspond. The neck and limbs are usually covered with soft skin, but scales like those of other groups of reptiles may be present, as in the sea turtles and in the large land turtles.

The dependence of turtles on a horny armor carries with it a loss of activity and accounts for the proverbial slowness of turtles. The extent to which they rely on this defensive protection is extremely variable. The snapping turtles and the swift-moving soft-shelled turtles are gregarious forms scarcely dependent on their shells for protection. Throughout the turtle group, however, we find adaptations for closing the shell completely. Our common box turtle is one of the most perfect examples of this tendency,

while the Blanding's turtle, with a much less perfectly hinged plastron, exhibits a halfway stage in the development of the same principle. In these turtles the plastron closes the shell at both ends by motion on a single cross-wise hinge. Many turtles from other regions and from other countries have two hinges in the plastron, closing the front and rear lobes separately. A widespread group of African turtles closes the rear of the shell by means of an imperfect hinge in the posterior part of the upper shell. In the land tortoises, which include the giant forms of the Galapagos Islands and the islands in the Indian Ocean, the openings at the front and rear are tightly blocked by the limbs, which are covered by heavy scales underlaid by bone.

The habits of turtles offer an interesting field for investigation. All turtles lay eggs and lay them on land, usually in sandy locations. There are considerable differences in the manner of egg-laying, and in the number in a clutch, the size of the egg, and the nature of the egg-shell, in the various groups of turtles. Some of our turtles have a peculiar kind of courtship in which the male faces the female and strikes her head and forelimbs actively with his much elongated claws. Careful observations of this performance are much wanted for our species. By far the most remarkable problem in turtle life-histories relates to the fertilization of the eggs, which apparently takes place three or four years before they are laid. There are consequently three or four sets of developing eggs constantly present in the body of an adult female, since eggs are deposited annually.

Most reptiles shed their skins in the process of growth and at intervals during adult life. This is conspicuously true of snakes, in which the epidermis is shed in a single piece. Skin shedding in turtles is very little understood and evidently differs radically in different kinds of turtles. The soft skin of neck and limbs is presumably renewed by constant loss and replacement, as it is in mammals.

The ringed appearance of the horny shields of the shell is due to annual growth periods, and these growth rings make it possible to determine the age of most turtles in temperate latitudes. As the normal adult size is reached, the rate of growth decreases, and the original growth rings are gradually effaced by the shedding of thin layers of the horny epidermis.

The classification and distribution of the turtles of the world is a highly interesting but complex subject, too extensive for the present essay. It must be mentioned that there are two very distinct marine types, the true leatherback, and the green turtle with its allies, both of which have the limbs transformed into flippers. The remaining nine families of turtles are aquatic and terrestrial in varying degree. The soft-shelled turtles of our fresh waters are almost as completely aquatic as the sea turtles, while at the other extreme the land turtles include true desert forms which are entirely independent of water.

North America is rich in turtles, with no less than 62 distinct forms north of Mexico out of a total of some two hundred species in the world. Ten of these 62 species are found in the Chicago area. Their names and arrangement according to families are as follows:

THE SNAPPING TURTLE FAMILY (Chelydridae)

1. Snapping Turtle (*Chelydra serpentina*)

THE MUSK TURTLE FAMILY (Kinosternidae)

2. Musk Turtle (*Sternotherus odoratus*)

THE TERRAPIN AND BOX TURTLE FAMILY (Testudinidae)

3. Spotted Turtle (*Clemmys guttata*)
4. Painted Turtle (*Chrysemys picta marginata*)
5. Map Turtle (*Graptemys pseudogeographica*)
6. Cumberland Terrapin (*Pseudemys troostii*)
7. Blanding's Turtle (*Lima blandingii*)
8. Eastern Box Turtle (*Terrapene carolina carolina*)
9. Ornate Box Turtle (*Terrapene ornata*)

THE SOFT-SHelled TURTLE FAMILY (Trionychidae)

10. Soft-shelled Turtle (*Trionyx spiniferus*)

There are a number of possible additions to this list, for several other species approach the limits of the Chicago area. Single specimens, however, no longer indicate the natural occurrence of a species, for turtles, like other reptiles, are subject to being casually picked up and transported by automobile from one part of the country to another.

KEY TO THE TURTLES OF THE CHICAGO AREA

- A. Shell covered with soft skin, margin not bony.
 Soft-shelled Turtle (*Trionyx spiniferus*).
AA. Shell covered with horny shields which overlie a bony boxlike framework.
 B. Plastron relatively small.
 C. Tail long and strong, carapace rough.
 Snapping Turtle (*Chelydra serpentina*).
 CC. Tail short, carapace smooth.
 Musk Turtle (*Sternotherus odoratus*).
 BB. Plastron well developed.
 C. Plastron with a hinge, the front and rear lobes nearly closing the shell.
 D. Plastron perfectly hinged; carapace highly arched; color of lower part of head and neck not sharply separated.
 E. Plastron with a conspicuous pattern of light lines on a dark ground color, carapace without a keel.
 Ornate Box Turtle (*Terrapene ornata*).
 EE. Plastron with irregular markings, or unmarked carapace with a low keel.
 Eastern Box Turtle (*Terrapene carolina carolina*).
 DD. Plastron with an imperfect hinge, color of lower side of head and neck sharply separated (pl. 1).
 Blanding's Turtle (*Emydoidea blandingii*).
 CC. Plastron without hinge.
 D. Carapace black, with small round yellow spots.
 Spotted Turtle (*Clemmys guttata*).
 DD. Carapace without round yellow spots.
 E. Carapace with broad, light markings bordering the horny shields.
 Painted Turtle (*Chrysemys picta marginata*).
 EE. No broad light lines on carapace.
 F. Plastron unspotted.
 Map Turtle (*Trachemys scripta geographica*).
 FF. Plastron with pairs of large black spots.
 Cumberland Terrapin (*Pseudemys floridana*).

SNAPPING TURTLE (*Chelydra serpentina*)

The snapping turtle is one of the most familiar of North American turtles. It is easily recognized by its rough shell, large head and limbs, and long tail. It reaches a large size, with a recorded length of shell of 14 inches and a maximum weight of about 30 pounds. Shell length in turtles is measured in a straight line, not over the curve.

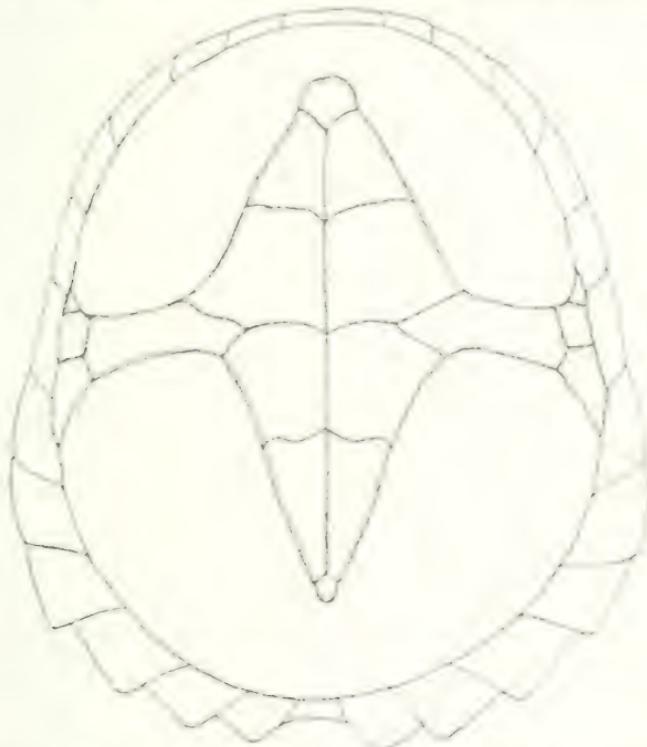


FIG. 1. The plastron of the snapping turtle in side view relative to the size of the opening of the upper shell.

of the shell. Its still larger relative, the giant snapping turtle of the Mississippi, is one of the largest of all fresh-water turtles.

The snapping turtle ranges throughout eastern North America and is found in the Mississippi and Missouri drainage system west to the Rocky Mountains. It is

an aquatic form, feeding in the water, but coming ashore to bask in the sun. It inhabits streams and rivers of all sizes, as well as lakes and ponds. It is capable of extensive overland migration, during which it is likely to be killed on highways and railroad tracks.

The name gives a clue to its disposition, for it is aggressive, and, if cornered on land, does not attempt to withdraw into the shell, but lunges forward viciously with its powerful jaws. Tapping or scratching the shell with a stick causes the typical reptilian reaction of raising the opposite side. When the middle of the back is tapped, the snapping turtle will rise as high as possible on its feet, its shell ridiculously like the arched back of a petted cat. Snapping turtles feed on all kinds of small animals that come within their reach. They lie in shallow water with the limbs and shell embedded in the mud, and capture their prey by sudden lunges of the head and neck. They are still more concealed in such situations by the algal growth which frequently forms on the shell. Some vegetable matter may be eaten, and it is reported that young specimens feed freely on the floating duckweed in stagnant water. They frequently feed on dead fish. An extraordinary use is made of live snapping turtles in the search for the bodies of drowned persons, by attaching a line to a captive turtle and following its movements.

The eggs, to the number of thirty or more, are laid during June in holes excavated in sandy embankments or fields. They hatch in late August or early September, and the young turtles go into hibernation with very little increase in size. The eggs are nearly spherical, about an inch and a quarter in diameter, with a tough leathery shell.

This species is widely used as food. It is captured in turtle traps, by seining, or with hook and line. It is shipped alive in crates. In the Washington and Philadelphia markets, snapping turtles are prepared simply by removal of the plastron and entrails.

Leathet No. 14



MAP. PLATE 14



MAP. PLATE 14

PLATE 2



MAP. PLATE 2



MAP. PLATE 2



MAP. PLATE 2

MAPS OF THE VARIOUS PLATES ON THIS SHEET WILL BE

MUSK TURTLE (*Stegnoterurus odoratus*)

The musk turtle is a small, dull-colored turtle with a rather high and elongate shell, usually under four inches in length. The scales of the plastron are separated by whitish areas of skin in the adults, much more widely in male specimens than in female. There are two yellowish lines on the side of the head. This species is known as the musk turtle or stinkpot, on account of its strong and somewhat disagreeable smell.

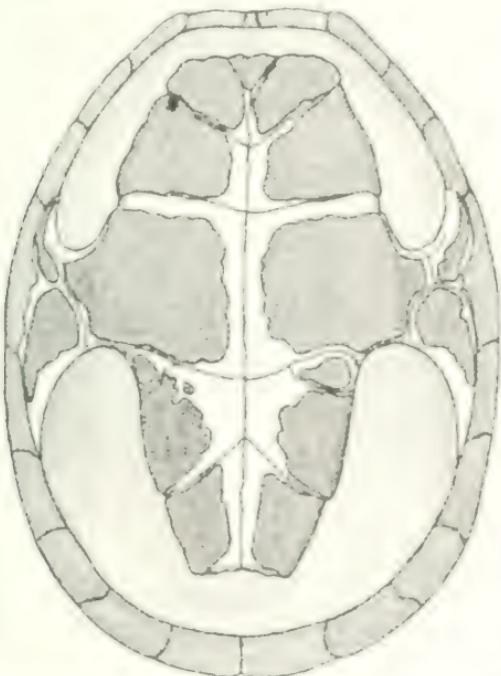


FIG. 2. Whitish areas of skin (shells) of the plastron in the adult musk turtle.

The musk turtle family is confined to the Americas, with a wide variety of peculiar forms in Central America. Our musk turtle is found throughout most eastern North America. There are two related species in the southern states, besides the numerous species of the allied *Kinosternon*. The musk turtle is strictly aquatic, coming ashore

for egg-laying or occasional migration, but otherwise keeping to the sluggish streams and ponds which it inhabits. A pair of opposing pads of horny spines on the hind limbs in the males of this species have been referred to as a "stridulating apparatus," but observations on the production of sounds by this means are still much to be desired. These turtles are the scavengers of lakes and ponds, feeding on any animal matter alive or dead that they may find while walking about on the bottom. The eggs are laid in middle or late June and hatched in late August or September. They are few in number, three to five in a clutch, elongated, and with a hard shell, about an inch in length and three-fourths of an inch in the smaller diameter.

SPOTTED TURTLE *Clemmys guttata*

The spotted turtle is a very easily recognized species, for its color pattern of small orange yellow spots on an almost solid black ground color is unique among American turtles. The plastron is reddish brown with black blotches on the ends of the plates. The shells of adult specimens are four to five inches in length. The coloration of the sexes is different, the figure on our plate representing a female. The jaws of the male are darker and the stripes behind the jaw and eye less distinct.

The genus *Clemmys* is world-wide in the northern hemisphere, with four species in North America, two in Europe, and four in China and Japan. The spotted turtle is the most abundant of the three species in eastern North America, ranging throughout the eastern United States with the exception of peninsular Florida. In the Chicago area it is fairly abundant in the Indiana dune region, but, except for a doubtful record from Wolf Lake, does not occur west of the Illinois-Indiana line.

The spotted turtle lives in swamps, ponds, and small streams. It is found abundantly on land during the

breeding season in early spring; but after egg-laying time is rarely seen. Little else is known about the habits of this species. Its eggs are few in number, three or four at most. They are relatively elongate, about an inch and a quarter in length by three quarters of an inch in the smaller diameter. The eggs are laid in the latter half of

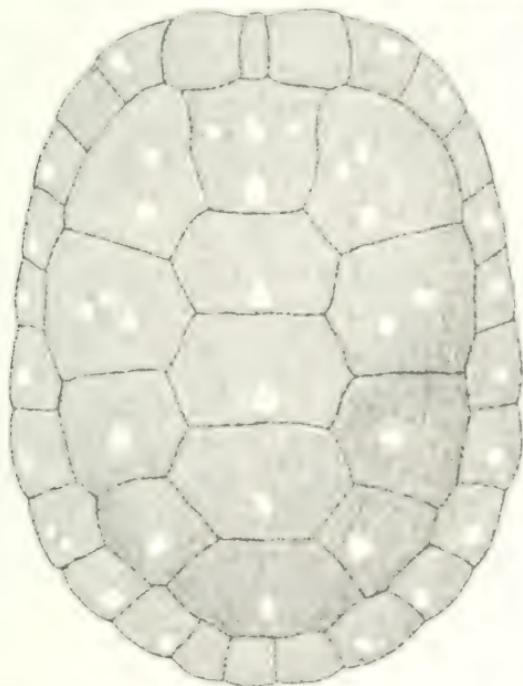


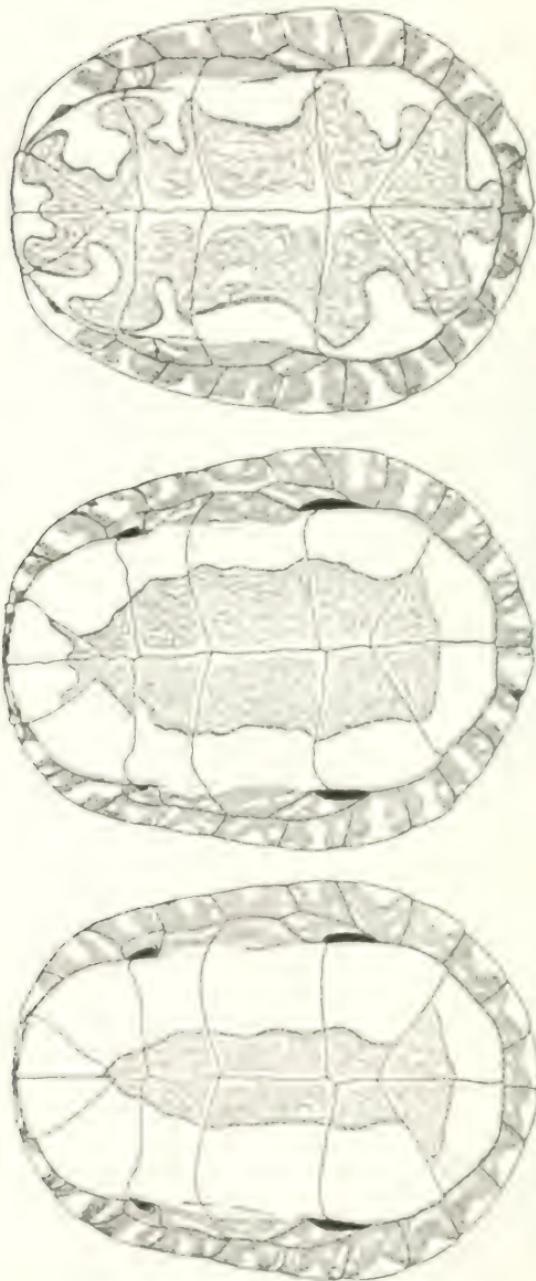
FIG. 3. The dark carapace of the painted turtle, shaded with small orange spots.

June in our latitude, and apparently do not hatch until some time in September.

PAINTED TURTLE, *Chrysemys picta picta*.

The painted turtle may be recognized by the rather broad light bands which border the sutures of the shields of the carapace. The plastron is yellow or red with an elongate central black marking, and the marginal shields are brightly marked with red. The average length of shell in full-grown specimens is between five and six inches.

FIG. 4. Variation in the black pattern of the plastron of the painted turtle. *a*. Typical narrow pattern (true pattern) of a specimen from Porter County, Indiana. *b*. Intermediate pattern (intergrade to wide band and narrow) from LaSalle County, Illinois. *c*. Typical pattern of true *lutea* from Clark County, Wisconsin.



The painted turtles of the subspecies *marginalis* range from western New York to western Indiana, south to the Ohio, and into southern Illinois. West of the Mississippi this subspecies is replaced by the western form *belli*, with a much more extensive black pattern on the plastron. The turtles of this group in northern Illinois are intergrades between these two subspecies, with a black ventral pattern of varying extent. The specimens from the Indiana dune region are typical *marginalis*. A more detailed study of this species from the Illinois rivers is desirable.

This form is perhaps the most abundant turtle of the Chicago area, especially numerous in the ponds and lakes of the moraine district and in the borrow pits along the dunes highway in Indiana, but numerous also along streams. It is especially given to basking in the sun on exposed logs and banks. The eggs number from four to eight. They are dull white in color, with a soft, easily indented shell. Egg-laying takes place in June, and although hatching occurs in August, hatched broods may spend the winter in the egg to hatch in May or June of the following year. The food of the painted turtle is miscellaneous animal matter.

MAP TURTLE (*Graptomyus geographicus*)

The map turtle is considerably larger than the spotted or painted turtles, reaching a shell length of more than ten inches. The carapace has a low but distinct keel on the mid-line, much more distinct in young specimens. The carapace is dark olive with a network of light yellow lines, while the plastron is uniform yellow, the shutes sometimes with dark lines along their margins. The head is large and broad, with a characteristic coloration, illustrated in plate 2.

The map turtle inhabits the central United States, from New York to Virginia and from lower Michigan to Texas. It has a widespread southern relativity, the

"pseudogeographic turtle," *Graptomys pseudogeographica*, which has a more sharply keeled carapace.

The map turtle is essentially aquatic, and partial to standing waters and sluggish streams. Its jaws are provided with broad crushing surfaces which adapt this species to its diet of mollusks and crayfishes. The eggs

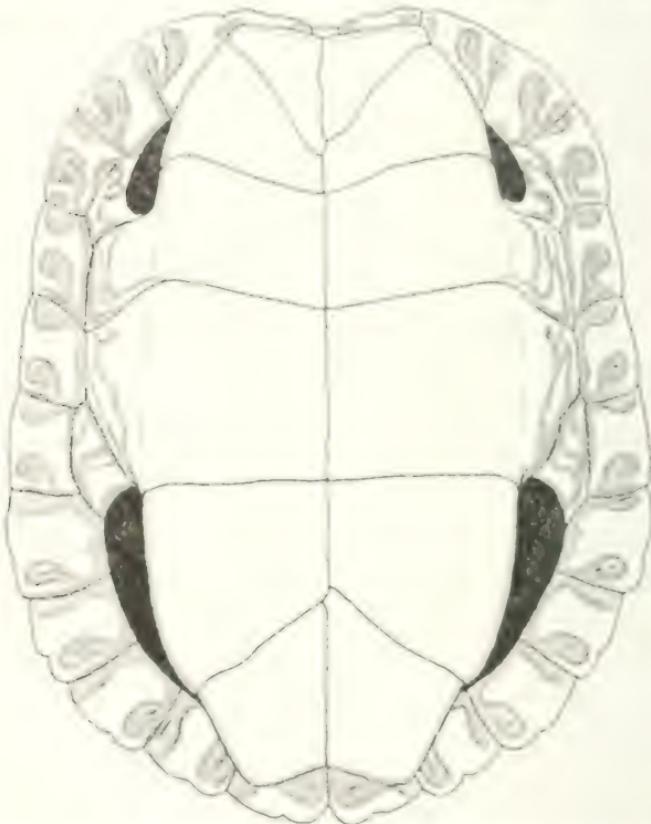


FIG. 5. The plastron of the map turtle is without black spots.

are leathery-shelled, ellipsoidal in shape, a little more than an inch in length. From eleven to sixteen eggs are laid in two layers in a flask-shaped excavation, with sometimes one or two eggs left over for the narrowed neck of the repository. The ground is carefully smoothed over by means of the plastron after the eggs are deposited and the

nest filled in. Egg-laying begins in early June and hatching takes place in September. If egg-laying is delayed, hatching may not take place until the following spring, the development of the eggs being arrested during winter, the embryos "hibernating" much as the young would have to do in normal autumn hatching.

CUMBERLAND TERRAPIN (*Pseudemys troostii*)

The terrapins of the genus *Pseudemys* are sometimes known as "sliders" or "cooters." There are many species of this genus in the southeastern United States, only one, the Cumberland terrapin, reaching the Chicago area. This turtle is a good-sized species, the shell about ten inches long, most easily recognized by its band of red or yellow on each side of the head and neck. The plastron is yellow with a black mark or circle on each shield. In the South, male specimens are frequently without the yellow color in the head and shell pattern, and have a very distinctive mottled black appearance, so that they were long regarded as belonging to a distinct species.

The Cumberland terrapin is extremely abundant in the rivers of the central Mississippi Valley, ranging northward to Wisconsin and eastward to Ohio. In the Chicago area it is known only from the Kankakee River, and it appears to be entirely absent from the dune region of northern Indiana.

This common species is doubtless predominantly carnivorous, like its relatives, but experiment with captive specimens shows that vegetable matter is also taken. Great numbers of newly hatched specimens of this species are sold annually to be kept as pets. While they make attractive pets for children, they do not usually survive the winter in our climate, apparently on account of lack of direct sunlight. Small specimens feed greedily on canned tuna fish.

Egg-laying takes place late in June. The female turtle, leaving the water in search of a nest site, chooses a

sandy bank, often at some distance from the water's edge, and excavates a hole to a depth of about six inches. About fifteen eggs are deposited by a full-grown turtle. The hole is carefully filled and the surface smoothed over with the hind legs and plastron. The time required for hatching is about eight weeks.

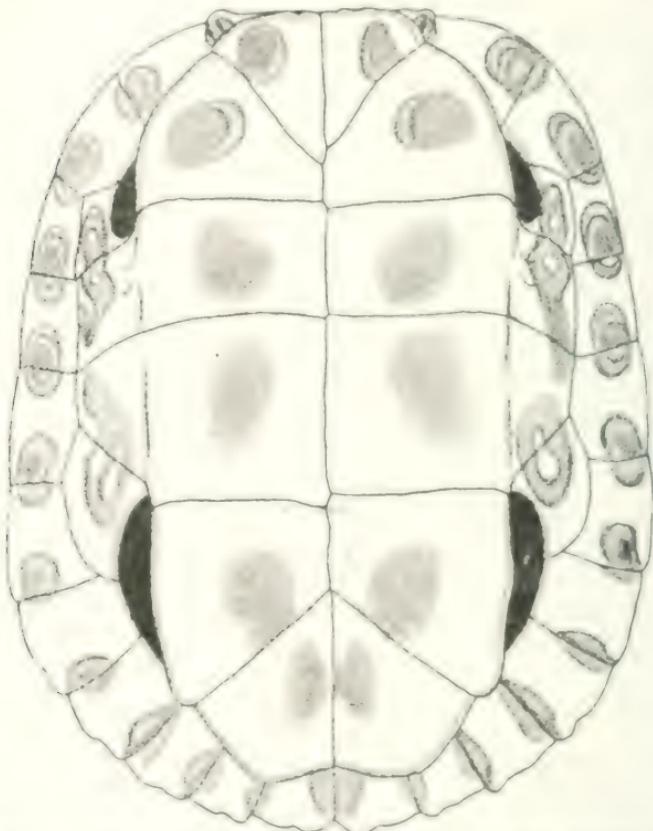


FIG. 6. The paired coupled black spots on the shields of the plastron are characteristic of the Cumberland terrapin.

BLANDING'S TURTLE. *Emydoidea blandingii*.

The turtle known as Blanding's turtle in books does not appear to have any current popular name. It is a very distinct kind of turtle, its nearest relative being *Emydoidea blandingii* of Europe. This turtle has a very

characteristic coloration, especially of the head and neck, as shown on plate I. The uniform yellow of the chin and throat meets the dark brown color of the upper surface in a sharply defined line. The carapace is black with yellow or brown spots and vermiculations. The plastron

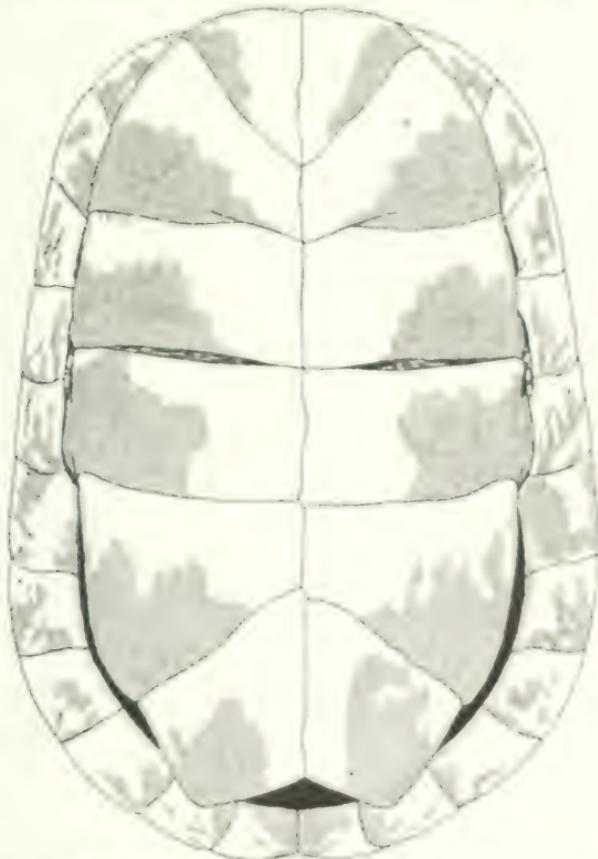


FIG. 7. The plastron of Blooding's tortoise is imperfectly hinged. The large black blotches on the outer corners of the shields are distinctive.

is yellow with a large black blotch on the outer part of each shield. The plastron almost completely fills the opening of the carapace, and is somewhat imperfectly hinged so that its two ends close against the upper shell. The usual length of an adult shell is about eight inches.

Blanding's turtle ranges across the northeastern United States from Iowa to New England and Long Island. It does not range far to the south. It is at least partly terrestrial, and appears to have been abundant on the Illinois prairies before they were completely settled. It is still moderately abundant in the Chicago area, especially in the dune region of Indiana and in the sandy region north of Waukegan.

Little is known of the habits of this species, though it is one of our most distinct and interesting forms.

EASTERN BOX TURTLE (*Terrapene carolina carolina*)

The box turtles are small turtles with a high, domed shell, very different in this respect from other turtles of the Chicago area. The name refers to the power of closing the front and rear lobes of the plastron completely, with the head and limbs withdrawn.

The pattern of the carapace in the eastern box turtle often consists of radiating dark lines on each shield. The coloration of this species is extremely variable. It may be uniform olive, without markings, and either dark or light markings may predominate. The plastron, however, though varyingly blotched with dark markings, never has the regular pattern of the ornate box turtle. The males are distinguished by having bright red eyes. Large specimens attain a shell length of six inches. The upper shell has a low but distinct keel on the mid-line.

The typical eastern box turtle ranges over the eastern United States from the Mississippi to Maine and Georgia. It is replaced by the three-toed subspecies *Terrapene carolina triunguis* in the Gulf coast region and westward, while on the Great Plains there is only the ornate box turtle.

These turtles are strictly terrestrial but they may occasionally enter water. Our subspecies frequents hard-wood forests. The box turtle is to a large extent herbivor-

ous, feeding on leaves, berries and mushrooms, but worms, caterpillars and other animal food are also taken. Captive specimens have been known to attack and eat horned lizards. The eggs are four to six in number, with a thin flexible shell. They are laid late in June and hatch in August or early September. The newly hatched young

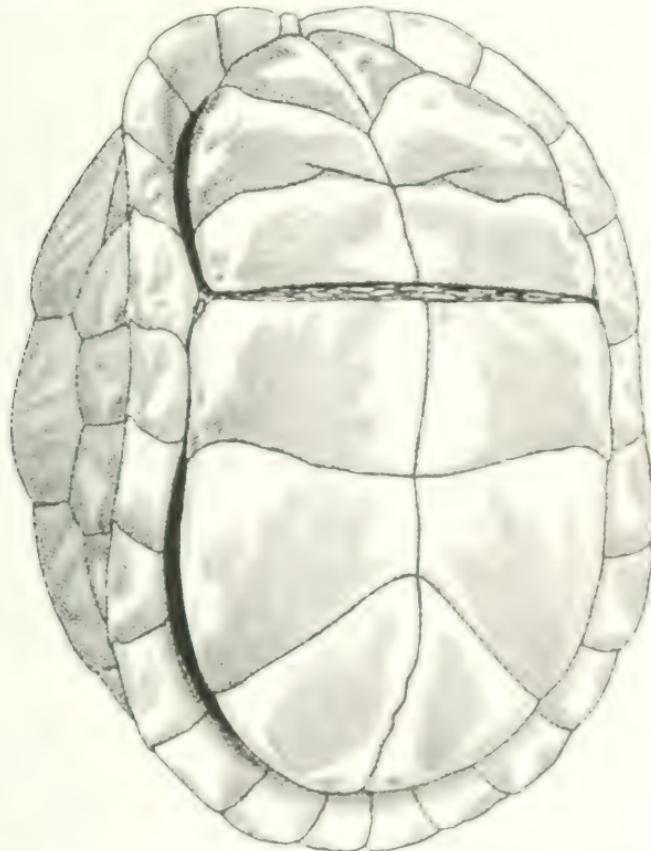


FIG. 8.—The plastron of the box turtle (*Terrapene ornata*), showing the hinge at front and rear.

are entirely without a plastral hinge, and look very ugly in the adults.

Some years ago Mr. and Mrs. C. M. Breder devised an ingenious means of studying the daily life of the box

turtle. This consists in attaching a spool of thread to the turtle's shell by means of a wire frame, so that the spool will unroll as the turtle progresses, leaving a thread trail wherever it goes. Some of the preliminary results of studies by Mr. and Mrs. Breder, made in New Jersey, showed that *Terrapene carolina* has a well-defined sense of direction; that each individual has apparently an area of rather circumscribed dimensions which it traverses and which it will attempt to reach if removed a short distance therefrom; that it wanders about rather at random when on its home territory; and that it burrows into leaf mold for the night, and is most active just after sunrise and before sunset, while, in emerging from a burrow, it proceeds to "plow" through the soft soil, not backing out in any case.

Similar observations and confirmation and extension of these conclusions might offer an interesting study in local natural history to some Chicagoan spending weekends or vacations in the dune region.

ORNATE BOX TURTLE (*Terrapene ornata*)

The ornate box turtle may be recognized by the bold pattern of the plastron, and it is distinguished in a number of other ways from the eastern box turtle. It is a somewhat smaller species; there is no keel on the middle of the upper shell, and this is less domed and somewhat flattened on top.

The distribution of this species is especially interesting, since it is a form common on the Great Plains, reaching its maximum abundance in Oklahoma and Kansas. In Illinois and Indiana it occurs only in isolated sandy areas. It is believed that this affords evidence for an important eastward spread of the plains vegetation and animal life in postglacial times. This was followed by the change to the modern climatic conditions, which are unfavorable to some of the western forms, with the result that they are restricted to special areas, especially to sandy areas, to which these plains animals are better adjusted.

Except for its evident preference for sandy areas, the ornate box turtle has habits greatly like those of its eastern relative. It is most curious that the western species, which is found in sandy areas in Lee and Kankakee counties in northern Illinois, should be absent in the Indiana dune region, and replaced there by the eastern species.

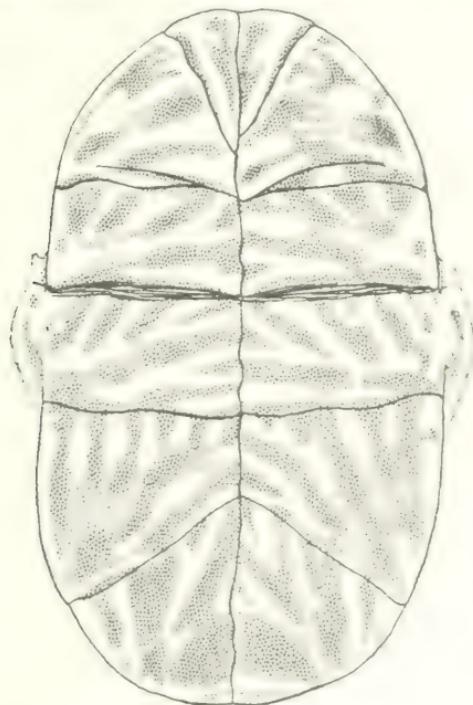


FIG. 9. The ornate box turtle is most easily distinguished by the handsome and symmetrical pattern on the lower shell.

SOFT-SHELLED TURTLE (*Trionyx spinifera*)

The most peculiar of all the turtles of the Chicago area is the soft-shelled turtle, a representative of a large group whose headquarters are in southern Asia. These turtles have no horny plates, the bony shell being reduced and covered with skin. The snout is produced into a slender tube. There is a series of soft spines on the border of the carapace in front. The olive gray carapace is

margined with yellow and spotted with darker spots which may be ring-shaped or surrounded by rings, but which usually disappear in old specimens. The length of the shell reaches twelve inches.

Our soft-shelled turtle ranges from the Rocky Mountains throughout the Mississippi and St. Lawrence basins to the Alleghenies in the east.

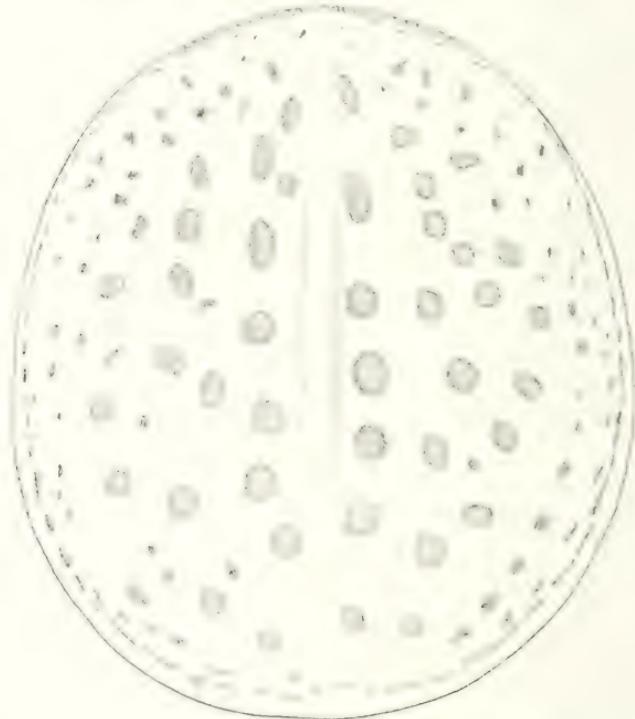


FIG. 10. Spotted carapace of soft-shelled turtle.

This species, like all its relatives, is completely aquatic, coming ashore only to sun itself and for egg-laying. Its powerfully webbed feet make it an excellent swimmer. It is somewhat surprising to find that it is quick in its movements on land. Young specimens, especially, run with great rapidity, high on their legs, belying the proverbial slowness of the tortoise. These turtles feed on animal matter, such as dragon-fly larvae, crayfishes, and

TURTLES OF THE CHICAGO AREA

presumably occasional fishes. They are frequently caught by fishermen with hook and line.

A curious deformity is occasionally found in the soft-shelled turtle, in which the back is raised into a hump. Such hump-backed turtles have been reported from the Chinese soft-shelled turtles as well as from our species.

The eggs are nearly spherical, hard-shelled, and number up to twenty-five, eighteen being the average clutch. They are laid in a flask-shaped excavation in banks near the water. Laying takes place during late June and the early part of July. The time required for hatching is not exactly known, but young specimens have been found in late August and early September.

This species is the most highly esteemed for food of all the middle western turtles, though its market value does not equal that of the diamond-backed terrapin of the Atlantic coast.

KENNETH P. SEAMON

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